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Table of Contents.

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ORIGINAL ARTICLES— Page.
Some Observations on the Prevention and Treatment of Tuberculosis, by Hilary Roche 293
Some Clinical Aspects of Tuberculosis, by Hilary Roche 299
The Tuberculous Lung Cavity and Monaldi's Closed Suction Drainage, by Hilary Roche 307

REPORTS OF CASES—
"Promin" in Tuberculosis: A Short Preliminary Review Accompanied by Short Clinical Notes of the Use of "Promin Jelly" (5%) in Eleven Cases, by J. A. R. Murphy 310

REVIEWS—
A Bibliography of Ophthalmology 312

LEADING ARTICLES—
The Modern Treatment of Pulmonary Tuberculosis in Australia 313

CURRENT COMMENT—
The Therapeutic Use of Radioactive Phosphorus .. 314

ABSTRACTS FROM MEDICAL LITERATURE—
Medicine 316

BRITISH MEDICAL ASSOCIATION NEWS—
Scientific 318
Notice 321

MEDICAL SOCIETIES— Page.
The Medical Sciences Club of South Australia 322

CORRESPONDENCE—
Two Pelvic Tumours 322
A Case of Lochiometra 323
The Royal Naval Medical Service and Australia .. 323
Ollier's Disease and Multiple Exostoses 323
Notification of Hydatid Disease in Victoria 323

OBITUARY—
James Thomas Wilson 323

THE ROYAL AUSTRALASIAN COLLEGE OF PHYSICIANS—
Notice 324

UNIVERSITY INTELLIGENCE—
The University of Melbourne 324

AUSTRALIAN MEDICAL BOARD PROCEEDINGS—
New South Wales 324

NAVAL, MILITARY AND AIR FORCE—
Casualties 324

MEDICAL APPOINTMENTS 324

NOMINATIONS AND ELECTIONS 324

DIARY FOR THE MONTH 324

MEDICAL APPOINTMENTS: IMPORTANT NOTICE .. 324

EDITORIAL NOTICES 324

SOME OBSERVATIONS ON THE PREVENTION AND TREATMENT OF TUBERCULOSIS.[1]

By HILARY ROCHE,
Melbourne.

PREVENTION.

The Decline in Tuberculosis: Causes.

WITH the exception of the last war and during the first three or four years of the present war, the death rate for tuberculosis in most civilized countries has been steadily declining since the middle of the last century. This decline has been attributed to many factors. According to the eminent authority Rich,[(1)] there is no evidence that a decrease in virulence of the bacilli has played any part. He does not consider that natural selection, by elimination of the most susceptible, has been a factor of any importance, though many would disagree on this point. Improved environment, especially higher living standards, has probably been the most important influence. Other factors, according to Rich, which have played a role are the anti-tuberculosis campaign, improvements in diagnosis and treatment, decrease in opportunities for contact infection, the decline in the birth rate, and the change in the age composition of the population.

With an increased consciousness among the public and our legislators of the possibilities of controlling tuberculosis, it is reasonable to expect that the decline after the war should be still more marked. Prospects in Australia should be particularly good, as we have such advantages as an abundant and cheap food supply, favourable climatic conditions, a relative lack of bad slums, and no serious problem of susceptible racial types.

[1] Read at a meeting of the South Australian Branch of the British Medical Association at Adelaide on February 22, 1945.

Extent of the Decline in Recent Years.

Although the death rate in any one year cannot be accepted as an accurate guide, it may fairly well reflect the true situation. A review of the rates in 1921 and in 1941 indicates approximately the decline during that twenty-year period. The decline was as follows:

Tuberculosis: All Forms.

Australia: 42·6%
Canada: 46% (white), 34·5% (white and Indian).
England and Wales: 34% (1920-1940), 40% (1920-1939), approximately.
United States of America: 54·5% (white and coloured).

States.

South Australia: 53·2%.
Victoria: 43·2%.
Ontario, Canada: 63% (white), 59% (white and Indian).
Quebec, Canada: 34·4%.
Saskatchewan, Canada: 61% (white), 25% (white and Indian).

The figures for the Canadian States are especially interesting. Activities in Quebec prior to 1941 were largely concerned with agriculture. Ontario, the neighbouring State, with the same severe climate, had a highly developed mining industry and was an important manufacturing centre. Further, it had a greater Indian population.

All these factors favoured a higher tuberculosis incidence. Its anti-tuberculosis programme, however, was much in advance of Quebec's, especially in the provision of beds and of case finding facilities. The results are reflected in the notable difference in the decline in the death rate in the two provinces. Saskatchewan has a particularly active anti-tuberculosis organization, but a relatively large Indian population. If we had an anti-tuberculosis organization as effective as Ontario's, the results here would be still more dramatic.

The Relationship of the Anti-Tuberculosis Campaign and Sanatorium Treatment to the Decline in Tuberculosis.

As regards the prevention of the disease, I shall discuss only the role played by institutional treatment.

Provision of Adequate Beds.

The result of mass surveys carried out in Britain, Canada and the United States of America is of help in indicating the number of beds which should be provided. Trail and others[3] concluded from the Royal Air Force survey of over 250,000 that 3‰ would need sanatorium treatment. Brooks[2] found, after complete investigation in hospital, that 3·3‰ of over 166,000 navy personnel had active pulmonary tuberculosis.

It was estimated in 1943 (by Mary Dempsey[1]) that, of 2,000,000 industrial employees who would have been examined in the United States of America by the end of that year, 5‰ would be found to have active disease, and of these 3‰ would need institutional treatment. This is an understatement for this section of the population, as the great majority of known sufferers from tuberculosis were excluded from the survey. Examination of over 250,000 of the white population of Saskatchewan, with a death rate of only 18 per 100,000, revealed 2·41‰ with active disease. Galbraith[5] found 5·6‰ with active disease among 100,000 recruits for the second Australian Imperial Force. This represents slightly less than seven cases per annual death for the Commonwealth at the time of the survey. In South Australia there are about 490,000 persons of fourteen years and over. If beds were provided at the rate of only 1·5‰ for this section of the population, 735 beds would be needed. This is equivalent to a bed to annual death ratio of over three to one, which is regarded in Canada and the United States of America as the essential minimum. This rate has already been exceeded in nine American States, Hawaii, and before the war in the Philippines. In Ontario, it is nearly four to one.

Canadian and American Experience.—The anti-tuberculosis campaign has been developed to a much greater extent in parts of Canada and the United States of America than anywhere else in the world. Provision of adequate beds has played a very important part in the elimination of infection and in the decline of the death rate. For example, in the Canadian provinces of Saskatchewan and Ontario, patients are promptly admitted for treatment and contacts and ex-patients closely followed. There are also very active case finding organizations. In Saskatchewan in 1921, 75% of the school children were positive tuberculin reactors. In 1941 the percentage was 15%. Among pre-school children on entry, in the capital city of Saskatoon, there were 3·2% positive reactors in 1936, and in 1942 only one-third of 1%. In Ontario, where I spent ten months in 1940-1941, tuberculin tests have also shown a marked reduction in the incidence of infection. The mortality rate, previously referred to, dropped in 1926 when the bed to death ratio was 1 to 1, from 58·3 per 100,000 to 36·0 in 1936, when the bed to death ratio was 2·5 to 1, and to 26·9 in 1940 when this ratio had risen to 3·6.

Distribution of Beds.

On account of present-day needs as regards treatment and rehabilitation, it is important that our tuberculosis institutions be completely reorganized and that the new beds provided should fulfil these requirements in the most efficient manner. As a result of the different distribution of our population, and the great distances between towns and villages in the country, our problem as regards the allotment of beds is different from that of England. Here, with our tendency to concentration of population in the capital cities, I feel we should very largely concentrate our beds in these cities. It is certainly time that the care of cancer and tuberculous patients was entirely separated. The treatment and general requirements of patients with these two diseases are different one from the other. I believe that from the point of view of treatment, rehabilitation, the teaching of tuberculosis, and economy in capital costs and maintenance, by far the best results would be obtained by the centralization of beds in large self-contained hospital sanatoria. I have discussed these advantages in a previous paper.[6] An institution of 500 beds in Adelaide would suffice for South Australia. In addition, a few beds would probably be needed for other smaller centres, and some for the tuberculous insane, for hostels or night sanatoria, and for a village settlement for chronic sufferers from relatively stabilized disease. The provision of special schools, residential and day, is an excellent plan for children who have recovered from heavy infection, especially for those with an unsatisfactory home environment.

The Modern Hospital Sanatorium.

The hospital sanatorium should be located on the outskirts of the city in an agreeable situation for the patients. It should have good communications. Every manifestation of the disease and patients of all ages should be treated there. In the planning of such an establishment we have much to learn from such institutions as the Forlanini Institute of Rome, the Mountain Sanatorium at Hamilton, Ontario, and the sanatoria at London and Toronto, Ontario. The Forlanini Institute is a particularly fine building, and in its equipment and organization appears to embody most of the essentials of the modern hospital sanatorium. It is situated about half an hour by tram from the centre of Rome. It was completed in 1936 and has a capacity of 1,300 beds, which can be expanded to 1,500. There is a sanatorium division of four pavilions, one floor for men, one for women, and a hospital division which includes separate sections for: (*a*) "surgical" tuberculosis generally; (*b*) patients for thoracic surgery; (*c*) tuberculosis involving the eye; (*d*) tuberculosis involving the skin; (*e*) patients with ear, nose and throat complications; (*f*) pregnant patients. This section has its own delivery rooms and, like the ear, nose and throat section, its own operating theatre. The university professor of obstetrics is responsible for the obstetrical care of these patients.

Although each section of the institution has its own small laboratory and X-ray screening facilities, the principal laboratories, diagnostic and research, as well as the radiological department, are located, with the main operating theatres and the administrative offices, in the hospital division. Patients with non-tuberculous chest diseases are cared for in a separate building in the institute grounds. Throughout the institute is an extensive underground system of tunnels carrying all essential services, the meals in electric wagons on rails. The Forlanini Institute is an important centre for training medical and nursing personnel in tuberculosis. It is also greatly used for the post-graduate instruction of Italians and foreigners. The director is the professor of tuberculosis in the University of Rome.

Finally, we have a great deal to learn from the Ontario sanatoria previously mentioned, especially from the point of view of treatment and rehabilitation facilities. In Australia, our operating theatres and after-treatment rooms in the surgical block should be air-conditioned in order that thoracic surgery can be carried on during the hot weather without interruption and without harm to the patients.

The Role of Institutional Treatment in the Elimination of Infection.

The role of institutional treatment in the elimination of infection is twofold; the one is passive and has to do with segregation of the infectious from the community; the other is active and concerns the rendering of individual patients non-infectious.

The effect of the former is seen in those Canadian and American States where incidence of infection and mortality rates have been strikingly reduced compared with other States where there is still insufficient bed accommodation. The greater the length of stay, the more the segregation factor operates.

Segregation.—In some of the Canadian provinces, the former concept of control over the disease is being replaced by the idea of eradication.[7] This idea, however, can be realized only by constant surveys to detect infectious

patients and by their segregation. The provision of sufficient beds to permit of segregation is the most effective method of eliminating infection. American and Canadian public health authorities regard the power of compulsory hospitalization as absolutely essential for an effective anti-tuberculosis programme. The disease can never be eradicated without such powers. At present, thirteen American States and the District of Columbia, as well as at least two Canadian provinces, have such powers. Telford and Bogen,[9] from their experience in Los Angeles County, concluded "that the isolation of open tuberculosis proved to be legally enforcible, financially feasible, socially acceptable and hygienically valuable". Banyai and Cadden[9] have stated that "the tuberculosis law should be explicit in its definitions, elastic and humane in its interpretation and judicious in its application". It has been found in Ontario that the very great majority of the patients will submit to institutional treatment without demur, but that powers of compulsion are necessary for a very few who will not cooperate. Provision for such persons is probably best made available in a special isolation section of a penal establishment. Persons so detained should be treated as patients and not as criminals, and their incarceration regarded as isolation and not as punishment.

"Combined Intensive Treatment".—The effect of the second factor is reflected by the high percentage of patients discharged with "negative" or no sputum in those institutions where "combined intensive treatment" is faithfully carried out. "Combined intensive treatment" is the phrase used by Kayne, Pagel and O'Shaughnessy[10] to signify intensive rest combined with collapse therapy.

Whitney and Dempsey[11] have examined the results of treatment of 3,224 patients admitted to 75 American sanatoria with positive sputum, and discharged alive in 1933. They found that 37% still had positive sputum, 38% had "negative" sputum and 25% were not reported on. Of the patients on whom reports were made, the following may be noted. Of 1,320, who had bed rest only, 62% still had positive sputum on discharge. Of 575, who had pneumothorax, 36% still had positive sputum on discharge. Of 329, who had phrenic nerve surgery, 37% still had positive sputum on discharge. Of 95, who had thoracoplasty, 20% still had positive sputum on discharge. At this time only about one-third of patients admitted received collapse therapy.

Whitney and Dempsey found that "every type of collapse therapy proved to be more effective than bed rest alone with reference to the conversion of positive sputum".

With the more extensive use of collapse methods (on at least two-thirds of patients admitted to Ontario sanatoria), only 22·7% of 1,968 patients who had had active reinfection type pulmonary tuberculosis were discharged in 1941 as "unstable or active".

John Alexander,[12] reviewing results in the Michigan State Sanatorium, stated:

> The fact that there were nearly three times as many arrested or apparently arrested in the collapse therapy series as in the unaided sanatorium treatment series is itself conclusive evidence of the value of collapse therapy. Collapse therapy creates a favourable condition under which the patient's heightened resistance may bring about complete healing of the disease.

Thus, "combined intensive treatment" can play a vital role in the anti-tuberculosis campaign. Further, individual survival is closely linked up with the presence of the tubercle bacilli in the sputum. I believe that we in Australia have lagged far behind Canada, the United States of America, Europe and Britain in the application of special collapse methods. Having discussed the role of the tuberculosis institution from the point of view of prevention, I shall now deal with the subject of treatment.

TREATMENT.

As a foreword, I wish to express my belief that all tuberculous patients should undergo a period of institutional treatment. The advantages are psychological, educational, the healthy surroundings, the constant specialist supervision and the possibilities of satisfactory rehabilitation.

Twenty years or so ago sanatorium treatment was regarded as having been reasonably successful if the patient's general condition improved, and if he learned how to live hygienically. With the rapid development of collapse therapy our point of view has changed. We should now regard every patient who leaves with a positive sputum as a failure. Further, we should feel that the patient's stay has been in some measure wasted, even with physical improvement, unless he has been satisfactorily rehabilitated. Therefore, in addition to the sanatorium regimen designed to improve resistance and collapse therapy to aid healing, we endeavour to see that the patients have every opportunity for self-improvement and a desirable occupation after discharge. The modern rehabilitation programme should be supervised by a full-time director with staff, and should include occupational therapy, vocational training, and education from kindergarten to the university, as well as "adult" education. Such programmes are actually in operation in Canada and the United States of America.

Rest.

As regards the sanatorium regimen, the basis of this should be general rest, wherever the localization of the disease. Rest should be continued until quiescence has been achieved or the maximum possible benefit obtained. I shall deal with this in greater detail in another paper.

Collapse Therapy.

As John Alexander[12] says, collapse therapy is in many ways "an unfortunate term". "It implies only a gross mechanical decrease in the size of the lung and does not suggest the value of mere pulmonary relaxation." The principal relative indications for collapse therapy broadly are: (*a*) active or unstable non-cavernous lesions, (*b*) cavitation, (*c*) empyema.

One essential condition is that there should be sufficient lung functioning to allow collapse without embarrassment of respiratory function. The patient's age, heredity, temperament and economic status are other factors which must be considered. A period of general rest, for weeks or months, may be indicated before the application of collapse measures.

In minimal disease asymptomatic minimal lesions in youth and young adult life may show marked instability. This appears to be especially characteristic of those which are actually an exudative lobular pneumonic focus. "The younger the patient the greater the tendency to exudative reaction."[13] In a minority of cases in younger patients, the lesion is a productive or granulomatous tubercle. In these cases the radiological shadow generally is smaller and the lesion usually tends to run a benign course. I believe that collapse therapy should be instituted early in the very great majority of patients under thirty with minimal disease exudative in character, even if asymptomatic. It should be carried out in any case in which the heredity, temperament or economic status appears likely to have an unfavourable influence on resistance. As John Alexander[12] writes:

> Tuberculosis is too dangerous and unpredictable a disease to justify any but the most certainly effective initial treatment. . . . A review of history and radiographs of patients whose disease has reached a hopeless state often shows that at one time in the course of their disease many of them presented ideal indications for some operation, often a minor one, and that many of them might have been saved if surgery had been used at the opportune time.

In younger patients I have not infrequently been disappointed by the occurrence of relapse after periods of conservative treatment of from six to twelve months' duration and even longer. On the other hand I have never regretted the induction of a pneumothorax in minimal disease. It should, however, be combined at the onset with a period of at least a few months of sanatorium *régime*. This brings me to the consideration of so-called "ambulatory pneumothorax".

Ambulatory Pneumothorax.

In some centres in the United States of America, notably Chicago, and on the Continent, ambulatory pneumothorax

has been practised. This refers to the induction and maintenance of pneumothorax from a dispensary or in private practice, with the patient living at home and in some cases carrying on at work without interruption. Its widespread use is certainly not justified. Neither should the practice be absolutely condemned. In some instances, with existing bed shortages preventing immediate institutional treatment, there is a place for ambulatory pneumothorax. It is in my opinion better to induce and conduct such a pneumothorax, in spite even of an unsatisfactory environment, rather than allow progression of the disease to occur from a policy of non-interference. If possible, however, the patient should not be allowed to work until satisfactory collapse has been established and the resistance consolidated.

Phrenic Nerve Paralysis in Preference to Pneumothorax in Minimal Disease.

O'Brien, of Detroit,[14] and others have advised the use of temporary phrenic nerve paralysis in preference to pneumothorax in many minimal cases. I feel, however, that control over the lesion is likely to be more complete with pneumothorax. Further, the risks from this treatment, if carefully conducted, are certainly less than those of the disease, even when the initial lesion is minimal.

Cavitation: Its Significance and Relation to Sputum.

In the very great majority of cases positive sputum comes from cavitation in the lungs. Such cavitation is usually demonstrable radiologically, sometimes only by such special methods as tomography or stereo-radiography. Barnes and Barnes,[15] in an analysis of 1,454 cases, found that the mortality increased and the duration of life decreased, with an increase in the size and number of cavities. Further, 85% of their patients with cavities were dead within fifteen years. The average duration of life in their series of patients who subsequently died was fifteen and a half months after the discovery of the cavity. Simpson[16] reviewed nearly 2,000 films of cavity cases and found that only 3·6% of the patients survived ten years. He also noted that the length of survival was determined largely by the size of the cavity or cavities. He concluded that the great majority of patients with cavities will not live longer than five years. As regards spontaneous closure, Alexander[12] estimated that this occurs in approximately from 10% to 30% of sanatorium patients. He attributes these differences in percentages to differences in size of the cavities, the condition of the surrounding lung, and to the duration of bed rest or at least of restricted physical activities. From my own experience of private and hospital patients I should say that fewer than 20% of cavities larger than one inch in diameter close spontaneously and remain healed.

Phrenic Nerve Paralysis.

Alexander,[12] reviewing over 1,600 of his own patients who had phrenic paralysis, states that it is "one of the most useful measures available for the treatment of pulmonary tuberculosis". Many of us would agree with this. Over a period of five years up to 1941, it was used according to Drolet[17] in the treatment of approximately 11% of patients in 99 American and Canadian sanatoria.

In the latter 1920's and early 1930's the nerve was frequently evulsed. In the last ten years I have rarely advised evulsion. Even in the case of a basal cavity, when permanent paralysis may eventually be indicated, a crushing operation should be tried first. It is impossible to foretell the clinical effects of phrenic paralysis. Hence it is important to avoid as a first procedure an irrevocable measure such as phrenic evulsion. Further, evulsion should not be used in the case of upper lobe lesions, as thoracoplasty may be needed later, when paralysis of the diaphragm would lower respiratory reserves and predispose to post-operative atelectasis of the lower lobe. Such paralysis in fact is always followed by some deficiency in respiratory function, and this deficiency can in some cases give rise to unfavourable symptoms.

In bilateral disease permanent paralysis would make contralateral collapse less well tolerated and less effective. The principal disadvantage of temporary paralysis by crushing of the nerve is the occasional failure to find and sever all accessories.

For success a marked rise in the diaphragm is not always essential. In the case of a cavity all that is needed is sufficient relaxation to minimize the inspiratory tug on its draining bronchus. In a review of some of his patients whose disease had been arrested or improved by the treatment, Alexander[12] found that in 80% the rise of the diaphragm did not exceed 6·0 centimetres. In 38% the rise was only 2·0 to 4·0 centimetres. In Alexander's experience the results were equally good for either lung and for upper or lower lobes. After phrenic paralysis, if pneumoperitoneum is not induced, the patient should lie on the affected side. This reduces costal breathing and helps further relaxation of the lung. During two recent years at the Austin Hospital the phrenic nerve was crushed on 98 occasions and evulsed in three cases. Of the forty Austin Hospital patients whose diaphragms were paralysed, 25 had their condition improved and the condition of 15 was stationary or worse. Of the 25 whose condition improved, 20 had a rise varying from 1·0 to 6·0 centimetres and five more than 6·0 centimetres. Of the 15 whose condition was not improved, 13 had rises between 1·0 and 6·0 centimetres and two over 6·0 centimetres. The apparent reasons for failure were: insufficient mobility of the diphragm with rise of 1·0 centimetre or less, four patients; disease predominantly exudative in character, poor resistance, two patients; moderate to extensive excavation with lung fixed by adhesions in region of cavity, nine patients. Of the 25 patients whose condition was improved the paralysis of the diaphragm appeared to play a determining role in thirteen.

Principal Indications for Phrenic Paralysis.

Minimal Disease.—As previously mentioned, some tuberculosis specialists advise the use of phrenic paralysis in preference to artificial pneumothorax in many minimal cases. I, personally, feel that in spite of its more serious complications, artificial pneumothorax should generally have preference over phrenic paralysis as the method of choice in these cases.

In Association with Artificial Pneumothorax.—Phrenic paralysis may be used in association with artificial pneumothorax as follows.

1. When apical adhesions cannot be divided, phrenic paralysis will give vertical relaxation, and predispose to healing.
2. When a lower lobe cavity (especially basal) persists, in spite of absence of adhesions, the addition of phrenic paralysis frequently brings about cavity closure.
3. For obliterative pleurisy, phrenic paralysis may be of value.
4. When phrenic paralysis is used before the termination of pneumothorax therapy, the reduction in size of the hemithorax is a factor in the maintenance of cavity closure.

When Artificial Pneumothorax is Impossible.—Phrenic paralysis may be used when artificial pneumothorax is impossible: (i) for minimal or non-extensive non-cavity lesions; (ii) for a cavity less than two and a half inches in diameter (larger cavities may be affected favourably if not fixed by pleural adhesions); (iii) for recurrent hæmoptysis on the side of suspected bleeding when no other surgical procedure is practicable.

In Conjunction with Thoracoplasty.—Phrenic paralysis may be used in conjunction with thoracoplasty:

1. As a preliminary measure—to improve the local and general condition. (Thoracoplasty is performed when the diaphragm is functioning again.)
2. In addition to thoracoplasty in tuberculous empyema, before the diaphragm is fixed by adhesions. This will help to diminish the size of the empyema space.
3. To control lower lobe disease following thoracoplasty for the upper lobe.

In Association with Monaldi's Intracavitary Suction Drainage.—Phrenic paralysis helps the substitution of the cavity space by diminishing the size of the hemithorax, and favours bronchial occlusion when it is used in conjunction with Monaldi's method of suction drainage.

Pneumoperitoneum.

During the last ten years pneumoperitoneum has come into favour. It is generally employed only as an adjunct to phrenic paralysis. Its use in this regard is limited. Its principal indications are: (i) To supplement phrenic paralysis if the rise of the diaphragm is insufficient to close a cavity or give adequate immobilization of non-cavity lesions. (ii) To try and control active disease immediately after parturition. If pneumoperitoneum appears to aggravate cough and sputum, or to be ineffective as regards cavity closure, it should be abandoned after two to three months' trial or earlier. Persistence in its use, when ineffectual, may encourage contralateral spread.

During the recent two-year period, just referred to, the method was tried in the treatment of 27 patients at the Austin Hospital. It was abandoned in seventeen cases after trials varying from one to five months. Ten patients had their condition improved, a few of them remarkably so.

Reasons for abandonment were:

Diaphragm not adequately paralysed ..	2 patients
Diaphragm rise less than one centimetre	2 patients
Moderate to extensive excavation with pleural fixation of the lung in the region of the cavity	8 patients
Disease worse	2 patients
Contralateral spread	3 patients
Aggravation of cough and sputum ..	1 patient

Pneumoperitoneum appeared to play a significant role in increasing the rise of the diaphragm in all cases in which improvement occurred.

Artificial Pneumothorax.

According to Drolet,[17] a census taken in 99 American and Canadian sanatoria on December 31, 1937, showed that 528‰ of adult patients were receiving this treatment. Four years later the ratio was hardly changed, 524‰. Most will agree that pneumothorax is one of the most satisfactory procedures in collapse therapy, provided that certain conditions are strictly followed. Many accidents and complications can thus be avoided.

1. Among these conditions is first and foremost the abandonment without undue delay of the pneumothorax, if a reasonable trial, a few weeks in some cases, a few months in others, proves ineffective in closing a cavity or in securing adequate relaxation of the diseased lung. As Thompson and Janes[18] state:

> There is no more certain method of producing tuberculous empyema than by putting tension on tuberculous lung contained in adhesions. It should be emphasized that the tissue in adhesions is frequently under considerable tension in the presence of quite negative intrapleural pressures. It is our belief that a pneumothorax which cannot easily be made efficient by cutting the adhesions or supplementary phreniclasia should be abandoned at once and another form of collapse used. This belief is substantiated amply by a 1940 publication of Jennings, Mattill and Nemic in a review of twenty years' experience with unilateral pneumothorax on 1,027 patients.

The results of pneumothorax are shown in Table I, taken from an article by Jennings, Matill and Nemic.[19]

TABLE I.

	Percentage Working.	Percentage Alive, Not Working.	Percentage Dead.
Satisfactory pneumothorax ..	81·9	13·4	4·2
Partly satisfactory pneumothorax	56·8	12·6	30·6
Unsatisfactory pneumothorax ..	23·1	10·2	66·2
No free space, therefore no pneumothorax	38·8	18·4	42·8

Jennings, Matill and Nemic give the following illuminating figures on the two last-mentioned groups of patients, who did not have a satisfactory pneumothorax: no further collapse—249 patients, 74·6% dead at the end of three years; further collapse—346 patients, 28% dead at the end of three years.

2. Another essential condition for efficient and safe pneumothorax therapy is regular X-ray screening, preferably before and after each refill, and regular radiographic control.

3. Thoracoscopy, with a view to adhesion section, should be carried out early in nearly all cases in which adhesions are demonstrable by radiography or in which their presence is suspected. This should be done between the second and sixth week after induction. Early division will lessen the risk of complications of pneumothorax and will ensure more certain healing of the pulmonary lesions. The most troublesome complication of this intervention is empyema, but its incidence decreases with increased experience and a conservative attitude on the part of the operator. There is no doubt but that the marked advances which took place in the early 1930's in the technique of adhesion section have radically altered the prognosis of pneumothorax therapy. Thoracoscopy should be carried out in from 40% to 70% of all pneumothorax cases; the earlier the disease, the less the likelihood of adhesions. During two recent years 113 patients were examined by the thoracoscope at the Austin Hospital, on the whole with good results.

4. The duration of treatment should be adequate. In some minimal cases refills may be abandoned with safety after two years, but in the great majority the treatment should be carried on for at least three years. In more severe cases refills should be maintained for four or five years or longer.

5. Healthy lobes should not be subjected to undue collapse. By the regulation of the amounts of air injected, and by the spacing of refills, an attempt should be made to obtain and to maintain a selective collapse, that is, of the diseased area. When the disease is confined to one lobe it is undesirable to keep the healthy lobe or lobes markedly collapsed. Such collapse will not only interfere unnecessarily with respiratory function during the treatment, but will also compromise the future efficiency of the lung.

Oleothorax.

Oleothorax has a very limited applicability. I restrict its use solely for purposes of "blockade", for example, in (i) obliterative pleurisy in cases in which it is very important to maintain collapse, and in (ii) extrapleural pneumothorax when the patient lives at too great a distance from the refill centre for weekly attendances. In either case fluid should not be present. Regular X-ray observation is important to detect any signs of fluid formation. This brings with it increased pressures and the risk of pleuro-pulmonary perforation.

Extrapleural Pneumothorax.

The indications for extrapleural pneumothorax are very small. Its principal value is its occasional use as a substitute for thoracoplasty in patients under twenty years of age and in bilateral disease when effective intrapleural pneumothorax is impossible. The cavity, however, should preferably be smaller than two inches in diameter, either in the upper lobe or the apex of the lower lobe, and not superficially situated. The presence of marked pleural adhesions renders likely the risk of tuberculous infection of the extrapleural space. "The more difficult the stripping of the pleura, the greater the possibility of subsequent empyema" (Thompson and Janes[18]).

Apicolysis with Plombage.

Apicolysis with plombage has a still more limited application. The only indication for which I have advised the operation is for a small centrally situated apical cavity, when intrapleural pneumothorax is impossible and extrapleural pneumothorax and thoracoplasty inadvisable on account of advancing age. The apex of the lung is freed from the chest wall through a similar surgical approach as for extrapleural pneumothorax. A special paraffin wax, warmed until soft, is introduced in small pieces into the extrapleural space. Not more than 300 grammes should be used. The wax solidifies and prevents the lung, where freed, from reexpansion.

Thoracoplasty.

In well-chosen cases thoracoplasty is one of the most satisfactory methods of collapse therapy. Drolet[11] states that in 99 American and Canadian sanatoria during the five years 1937 to 1941, thoracoplasty was carried out in the treatment of 4% of patients admitted.

Indications.

We do not in Australia appear to make sufficient use of this valuable operation. I have advised thoracoplasty, except in empyema cases, only when toxic manifestations are minimal or non-existent, and when pneumothorax is impracticable. Preferably any cavity present should be less than three inches in diameter. The operation may be advisable in the presence of "honey-combing" with sputum or gastric contents positive for tubercle bacilli. I have recommended the operation in the presence of a cavity demonstrable radiologically, with "negative" sputum, owing to doubts about the stability of the lesions. I have not advised it in the presence of exudative parenchymatous disease. If such disease is always regarded as an absolute contraindication, the results of thoracoplasty are highly satisfactory. This exclusion, however, will mean that some patients, who might be helped by the operation, will be deprived of its benefits. There is no doubt but that a small percentage of patients with exudative disease will respond favourably. The majority, however, will develop complications. The difficulty lies in the selection of suitable cases. Any disease in the opposite lung should be quiescent or under control by some other form of collapse treatment, for example, artificial pneumothorax. Bilateral partial thoracoplasty is very rarely indicated. Chronic empyema (tuberculous or mixed) is another important indication for the operation. It should be done before thickening of the parietal pleura becomes so marked as to prevent collapse of the empyema cavity, or before any underlying pulmonary cavity, previously closed, reopens.

Results.

With careful choice of patients, the operative mortality is less than 5%, and the after-results are very good. Thompson and Janes[12] report sputum conversion "from positive to negative" in 83·5% of 128 cases. Of 177 patients consecutively operated on at the University of Michigan Hospital from 1934 to 1937, 79·1% had closed cavities and "negative" sputum in 1939, as reported by Sommers and Ehler.[13] Equally good results are obtained in other centres which have the same high standard as Toronto and Ann Arbor. During the last three years, 23 patients have been submitted to thoracoplasty at the Austin Hospital in the surgical service of Mr. C. J. Officer Brown. Two of these were operated on primarily on account of empyema. Of the 23, 20 had positive sputum before operation, and the sputum of seven is still positive, but one has a cavity in the other lung. Three patients had "negative" sputum before operation, and the sputum of 14 is now negative, "conversion" taking place in 11 cases. Lung cavities have apparently been closed in 13 cases. Three patients are well and working. Three are well, but not yet working, and ten are still in hospital or sanatorium. The condition of six of these patients is improved. The condition of one is stationary and that of two is worse. Another patient is awaiting a long-delayed second stage. Five were discharged from hospital improved. Two are dead. One, a man, aged forty-six years at the time of operation, developed a post-operative atelectasis of the lower lobe with subsequent spread of disease in that lobe. He made a partial recovery, but died at home about a year after operation. The second fatal case was that of a woman, forty-seven years of age. She died of sudden heart failure four days after the first stage. Her electrocardiograph was within normal limits, but *post mortem* the heart muscle was very soft and the right side of the heart markedly dilated. It is probable that if her cardio-respiratory function had been closely investigated on modern lines, this woman would not have been submitted to thoracoplasty. This intervention must obviously be a much more serious trial for those over forty years of age than for younger patients. One man of forty-four had bilateral thoracoplasty, two operative stages on each side. During the series several post-operative complications were encountered. These included shock, paradoxical respiration of the decostalized chest wall, lobar and lobular atelectasis due to bronchial occlusion with cavity secretions, bronchopneumonia, cardio-respiratory failure, spread of disease, secondary anæmia, pleural effusion, traumatic pneumothorax and pyogenic wound infection.

The post-operative care of a patient submitted to thoracoplasty provides a fascinating task for the medical attendant and the nurse.

At the Austin Hospital we have used the modern paravertebral thoracoplasty. There are, however, a small percentage of patients who may be better treated by the addition of an apicolysis as advised by Semb, of Norway, and further developed by Overholt in the United States of America and by Price Thomas, of London. The apex is freed by division of the bands and ligaments by which it is suspended. According to Thompson and Janes,[14] the operation is indicated more for small thin-walled cavities lying medially near the apex surrounded by a good deal of healthy lung. Cyclopropane anæsthesia (Dr. R. H. Orton) was almost invariably used.

Preliminary Treatment and Investigations.

Before thoracoplasty the patient may need three, six or twelve months or more of sanatorium treatment before being suitable for operation. Supplementary treatment such as phrenic nerve crush with or without pneumoperitoneum, or Monaldi's cavity suction drainage may be required as a preliminary.

Bronchoscopy should always be carried out if endobronchial tuberculosis is suspected. Bronchography is very occasionally indicated.

Vineberg and Kunstler,[15] of Montreal, advise that pressure readings should be taken of all cavities of more than one inch in diameter before thoracoplasty. Such readings will differentiate a patent from a stenosed bronchial outlet. Even if the cavity wall is sufficiently flexible, a cavity with stenosed communications which cause positive intracavitary pressure is unlikely to be closed by the relaxation afforded by thoracoplasty. Vineberg and Kunstler advise suction drainage prior to thoracoplasty for all such tension cavities. They also recommend that suction drainage should be used in the treatment of large apical cavities, which are directly in contact with the anterior pleura. In this instance they first do an anterior stage thoracoplasty, then they induce suction drainage. When the cavity has shrunk, they carry out a posterior upper stage thoracoplasty with the catheter *in situ*. In addition to a study of the bronchial-cavity relationship, other pre-operative investigations include the comparison of serial radiographs and serial blood examinations with special reference to the sedimentation rate, the differential white cell count and the hæmoglobin value. Tomography is most helpful. Further, the simple dye test of the urine for vitamin *C* deficiency should be done so that any lack of this vitamin can be combated. Vitamin *K* should be given if hypoprothrombinæmia is present. The patient's chart needs careful observation.

It is also most important that cardio-respiratory function should be investigated as fully as possible when any irrevocable collapse measure such as thoracoplasty is considered. I shall deal with these tests in another paper.

Resection of Lung.

So far we have done no lobectomies or pneumonectomies for tuberculosis at the Austin Hospital. With greater experience of its use in tuberculosis and further technical improvements, the operation probably will have a definite place in our therapeutic methods. At present its principal indication appears to be undilatable bronchial stenosis causing toxæmia from atelectasis and suppuration.

The use of pulmonary resection has been reported in the American literature for tension cavities, tuberculoma, extensive ulcerofibroid disease with associated bronchiec-

tasis, and for cavities persisting after thoracoplasty. According to Overholt,[32] tuberculous bronchitis, even if active, is not regarded as a contraindication. In some cases it is an indication for resection. The greatest risk of the operation appears to be contralateral spread.

Chemotherapy.

Arnold Rich[1] has pointed out that tubercles and caseous areas offer no barrier to the penetration of chemical substances if readily diffusible. There is, therefore, every hope that an effective chemotherapeutic agent will yet be discovered. Promizole, which has been developed in the Mayo Clinic, is so far the most effective substance found. Feldman, Hinshaw and Mann[28] state:

> Although of considerable effect in combating tuberculosis in guinea-pigs, promizole, like 4′ diaminodiphenylsulphone, promine and diasone, does not meet all the critical requirements for the perfect tuberculochemotherapeutic agent. . . . The low toxicity of promizole for human beings and the tuberculotherapeutic properties of the drug in experimentally infected guinea-pigs appear to justify its clinical trial.

Diasone, which received such publicity in the lay Press last year, has not, it seems, fulfilled expectations after a large-scale trial.

The discovery of a really effective chemotherapeutic agent would certainly revolutionize the treatment and prognosis of the disease. Nevertheless there would still be need of sanatoria, as the treatment would necessarily take some months. Further, surgical measures would be required for the majority of cavity cases as at present.

Summary.

Reference is made to the causes of the decline in the death rate from tuberculosis. The decline in a few different countries and States is compared. The important influence of the anti-tuberculosis campaign, especially the provision of adequate beds, is emphasized. The desirable features of a modern hospital sanatorium are discussed. The important part played by institutional treatment in the elimination of infection by segregation and "combined intensive treatment" is demonstrated by results obtained abroad.

The treatment of pulmonary tuberculosis with special reference to the different methods of collapse therapy is dealt with in some detail. The essential conditions for successful pneumothorax are stressed. Finally, the hopeful outlook for chemotherapy is mentioned.

Acknowledgements.

In conclusion, I wish to express my thanks to Dr. J. Bell Ferguson and Mr. C. J. Officer Brown, F.R.C.S., for permission to make use of the clinical material for this paper. I am very grateful to my wife for the time and care she has given to the preparation of the charts, diagrams and slides.

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SOME CLINICAL ASPECTS OF TUBERCULOSIS.

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THE CARE OF PATIENTS WITH PRIMARY TUBERCULOUS INFECTION, AND WITH SOME POST-PRIMARY MANIFESTATIONS, WITH SPECIAL REFERENCE TO PLEURISY.

Symptomatology.

WITH the decline in the incidence of tuberculosis, more and more primary infections take place in adolescence and early adult life. This is particularly true of persons without family contacts. However, only a small minority of those infected will develop symptoms. These may be referred to the chest, or may be general. They may occur as such so-called post-primary manifestations as *erythema nodosum*, or pleurisy with effusion, or rarely as phylectenular conjunctivitis. Cough is fairly common. Sputum, if present, is usually mucoid unless a lesion should liquefy. Chest pains, respiratory in character, are fairly common, but it is rare to hear a pleural rub. The commonest general symptom is malaise due to a rise in temperature. This is usually under 100°, but sometimes is higher. These patients may be labelled "P.U.O." (pyrexia of unknown origin) until a definite diagnosis can be established.

Mediastinal Lymphadenitis.

The younger the patient, the greater the likelihood of marked reaction in the regional lymph nodes. Such reaction is less common in the second decade as compared with the first, and still much less common after twenty years of age, except in susceptible types. It has been noted among the coloured population in the United States of America, and among other "native races" and susceptible persons that the tendency to marked lymph nodal reaction persists well into adult life.

Diagnosis.—Diagnosis can be made only by radiography. Lateral views are essential. Without high-powered apparatus, small focus tubes and good technique, lateral views are likely to be of little help in such cases. Interpretation, even with the highest technical standards, is often difficult. Serial films are often most instructive in revealing changes in the size of the glands. Tomography is most useful in the detection of enlargement of the mediastinal glands, even if slight.

[1] Read at a meeting of the Victorian Branch of the British Medical Association on March 7, 1945.

Physical examination of the chest is quite unreliable in these conditions, except in pleural effusion. A Mantoux test is essential. Culture of the fasting gastric contents may be most helpful in some cases. Some authorities advise it as a routine measure.

Erythema Nodosum.

Erythema nodosum sometimes develops soon after primary tuberculous infection. It is apparently a sign of a hypersensitive state. *Erythema nodosum* may have a varied ætiology. When it is tuberculous in origin, the Mantoux test gives a strong reaction, and there may be a recent history of contact. Associated chest symptoms and positive radiological findings, possibly enlarged mediastinal glands or evidence of pleurisy, would confirm the diagnosis.

Phlyctenular Conjunctivitis.

Phlyctenular conjunctivitis is also a manifestation of hypersensitivity. It appears to be more common in children than in adolescents and young adults. Its occurrence, as in the former condition, calls for the immediate performance of a Mantoux test and adequate radiological investigations.

Pleurisy.

Pleurisy is not an uncommon development following primary infection. It may be due to subpleural foci, or to involvement of the parietal pleura in periadenitis of the mediastinal glands.[1] Pain may be referred from such a site. Frequently the pleurisy is dry and pain in the chest, rarely dysphagia, is the only symptom. The practitioner should remember that the absence of a rub does not exclude the presence of pleurisy. Effusion may occur following such pains, without warning, or after a prodromal period of malaise. In addition to the performance of the Mantoux test and X-ray examinations, the fasting gastric contents should be examined by cultural methods for tubercle bacilli. A specimen of the pleural fluid should be removed for bacteriological investigation. Hudson[2] and Milne[3] emphasize the necessity of using an adequate amount of fluid. Each found the percentage of positive results increased notably, the greater the amount of fluid centrifuged.

Administrative Measures.

In all these manifestations of tuberculosis certain measures are required from the public health and administrative point of view. These relate to the management of the patient.

Notification.

Notification is important from the point of view of the community and the individual patient. The Joint Tuberculosis Council of Great Britain recently proposed[4] the adoption of a special form of notification, termed "intimation". "Intimation" would be confined to all tuberculous manifestations which were not obviously open or progressive. It would enable the tuberculosis authority to (*a*) seek the source of infection, (*b*) examine other possible contacts, (*c*) provide institutional care, (*d*) arrange financial allowances, and (*e*) undertake the long-term supervision of the patient.

This form of notification should be adopted in Australia. Further, a special effort should be made to secure from the profession much better cooperation as regards notification. The record in Victoria in this respect is not at all good. The annual average ratio of notifications to deaths was as follows: in Victoria, from 1922 to 1932, 1·1 to 1, and from 1933 to 1943, 1·2 to 1; in South Australia, from 1921 to 1940, 1·55 to 1; in New South Wales, from 1935 to 1944, 1·90 to 1 (this includes some cases notified after death); in England and Wales, from 1938 to 1941, 2·11 to 1; in the United States of America, in 1943, only 2·10 to 1.

Institutional care is indicated for the majority of patients with symptom-causing primary infection, and for children who have had heavy primary infection, or whose heredity, resistance or home environment is unsatisfactory. During the active phase the child should be in a special section of a sanatorium. When the disease appears arrested, the child can go to a non-residential special school if the home conditions are good. Otherwise a residential school is indicated. There are many of these on the Continent, public and private, in the mountains and at the seaside.

As regards adolescents and young adults with serious primary infection and with manifestations such as pleurisy, they should be cared for in a special section of a sanatorium. Erwin[1] states:

> It has already been shown that a minimum of 10% of patients (with pleural effusions) are infectious by ordinary methods, and it may be inferred from the nature of the disease that the actual incidence (of active infection) might well be two or three times as high.

In any case these patients are tuberculous. They need basic management and rehabilitation similar to that provided for patients with frank pulmonary tuberculosis. When they are looked after in a sanatorium, the tuberculous nature of their illness and the necessity for adequate after-care will become obvious to them. Further, in a sanatorium they have the advantage of supervision by tuberculosis specialists. In England, where there has always been a great shortage of sanatorium beds, the London County Council has opened a "Pleural Effusion Unit" in its hospital for chronic non-tuberculous diseases at Sidcup. The superintendent, Dr. Clifford Ellingworth, of Melbourne, has described the activities of this unit,[5] which now consists of 140 beds, three-fifths for males. In conclusion, Dr. Ellingworth made a plea for the abandonment of "the short-term convalescence so frequently considered sufficient at present", and for the establishment of similar units throughout the country.

Financial Allowances.

The provision of financial allowances for these patients and their dependants, if any, is essential. The Pensions Department apparently makes no grants for the long convalescent period which should follow most symptom-causing primary infections. Such a policy results in most instances in too premature return to work. A later result sometimes is a long period of pensionable disability in the form of frank pulmonary tuberculosis.

Regular supervision is essential as part of the after-care following discharge from hospital. Patients with unsuitable home environment should live in a hostel or night sanatorium for the first year or so.

The Management of the Individual Patient while under Treatment.

The Importance of Rest.

General rest should be the basis of treatment until all signs of systemic disturbance have disappeared. For the great majority, bed is required at first with a gradual increase of physical activities. In deciding as to the duration and degree of rest, I have been guided largely by the patient's symptoms, the radiological appearances, the temperature and pulse rate, and the blood assessment. After defervescence, the use of serial estimations of the blood sedimentation rate and of examinations of the white blood cells is an additional safeguard to the controls more commonly used. Like every other clinical method, which deals with only one phase of the body's reactions to disease, the blood sedimentation test has marked limitations, especially if considered independently of other findings. Further, its susceptibility to outside temperature changes and its other anomalies need to be recognized for correct interpretation.

Rich[6] has summarized the situation as regards the white blood cells, with the statement that, when uncomplicated by intercurrent infection or other circumstances, the differential leucocyte count "provides information as to the state of the disease at the time that the blood is withdrawn. . . ." Frequent differential counts must be made and the results correlated with clinical observation and other laboratory procedures. "Thus, valuable corroborative evidence may be forthcoming from this procedure." Sometimes the leucocytic formula may even indicate "the direction in which the disease process is headed, before the clinical or other laboratory procedures have revealed

ILLUSTRATIONS TO THE ARTICLE BY DR. HILARY ROCHE.

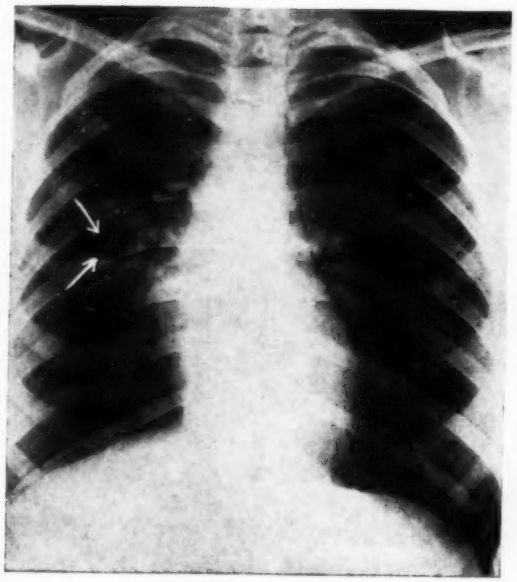

FIGURE I.
Case I: Phrenic paralysis supplemented by pneumoperitoneum—woman, aged twenty-four years. Cavity right mid-zone, pneumothorax impossible.

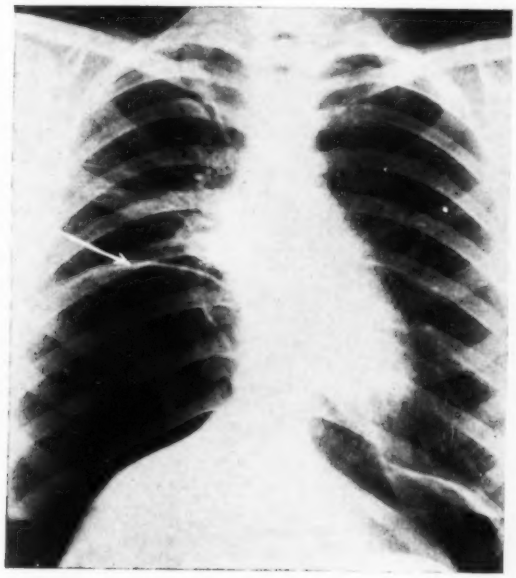

FIGURE II.
Same case as Figure I. The cavity became smaller, but was still present five months after a right phrenic crush and rest in bed. The condition is shown three months after induction of pneumoperitoneum. Cavity closed. Arrow indicates diaphragm.

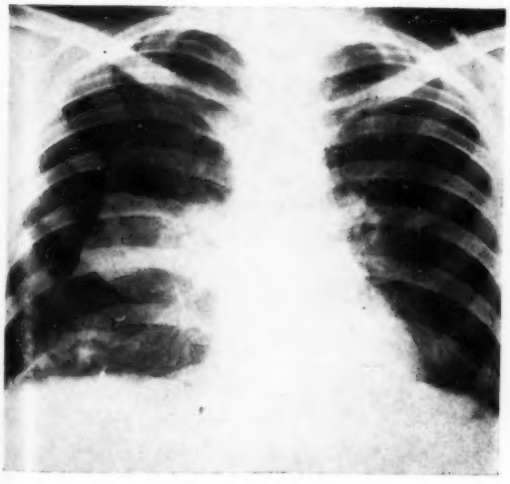

FIGURE III.
Case II: Oleothorax used as "blockade" in obliterative pleurisy in artificial pneumothorax—boy, aged eighteen years. Pneumothorax controlling diseased right upper lobe. No sputum.

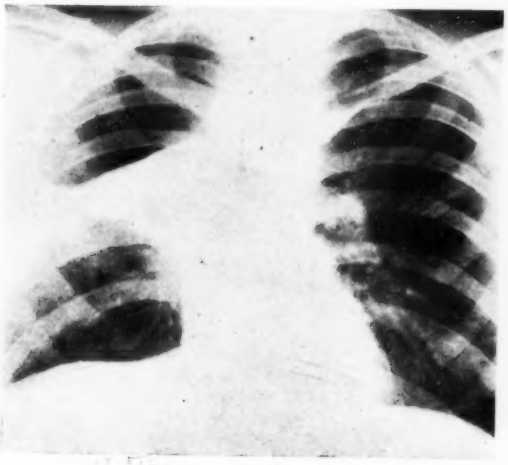

FIGURE IV.
Same case as Figure II. Following pleurisy, base of lung becomes generally adherent and lower lobe gradually creeps up chest wall. Cough and positive sputum reappear.

ILLUSTRATIONS TO THE ARTICLE BY DR. HILARY ROCHE.

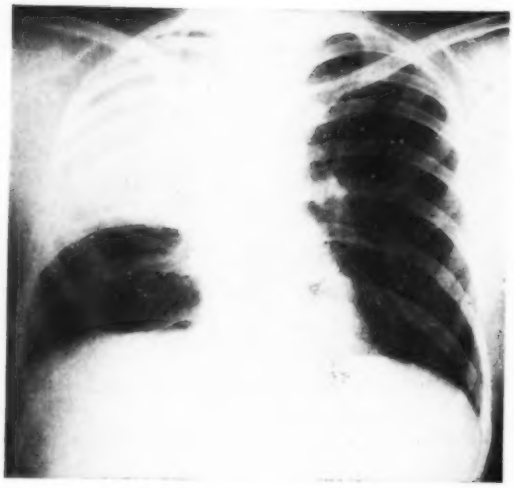

FIGURE V.
Same case as Figure II. Pleural cavity filled with paraffin. This prevents lung from becoming more adherent. Cough and sputum disappear.

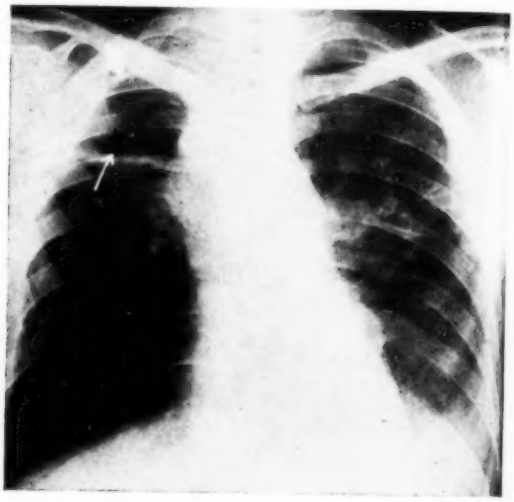

FIGURE VI.
Case III: Monaldi's transpleural closed suction drainage of tuberculous lung cavity—man, aged twenty-four years. Large cavity right upper lobe. Scattered infiltration, fibrosis and small pleural effusion, left side.

FIGURE VII.
Same case as Figure VI. After five months suction drainage, sputum and cavity secretions become persistently "negative" for tubercle bacilli on culture. Cavernogram (lipiodol injected into catheter) shows cavity reduced to a slit with stenosed bronchial outlets.

FIGURE VIII.
Same case as Figure VI. Film, after withdrawal of catheter. No evidence of cavity. Patient asymptomatic. Cavity did not reexpand. Disease arrested for past two years.

it". My experience in the use of the leucocytic formula, which extends over many years, suggests prudence in the prescribing of graduated exercise in these primary and post-primary cases, if there is a persistently poor polymorphonuclear cell:lymphocyte:monocyte ratio, and if there are an unduly large number of young (single and two-lobed) polymorphonuclear cells.

Duration of Convalescence.

Adequate convalescence is needed to raise resistance, encourage healing and minimise the risk of relapse. As a working basis, in the case of adolescents and young adults, the following minimum periods would probably suffice: three months for phylectenular conjunctivitis or *erythema nodosum* with no or only transient systemic disturbance, and unassociated with pleurisy, or with any obvious X-ray infiltration or lymphadenitis; six months for dry pleurisy similarly without any other obvious focal signs; nine to twelve months when mediastinal lymphadenitis has been demonstrable radiologically; twelve months for pleurisy with effusion, without any obvious pulmonary infiltration.

A Review of Some Patients with History of Pleurisy.

Sanatorium patients not infrequently give a history of pleurisy. Often one finds that very little importance was attached by the patient or the practitioner to the pleurisy at the time of its occurrence. No Mantoux test or radiological examination was advised. In other instances a radiograph was taken, but following a negative report no further X-ray supervision or regulation of the patient's activities has been carried out. These omissions later may have serious effects for the patient.

Thanks to the kindness of Dr. Rosenthal and Dr. Marshman, of Gresswell Sanatorium, of Dr. Henry Watson, of Heatherton, and of the medical officers of the Austin Hospital, an investigation was recently made of the incidence of pleurisy prior to admission to hospital among 336 patients. One hundred and nine gave such a history, "dry" in 91 cases, with effusion in 18. Of these patients, 69, including 16 with effusion, had had their chests examined radiologically following the pleurisy. Thirty-five were actually admitted to hospital on account of the pleurisy or associated symptoms of active pulmonary tuberculosis. Of the remaining 74, only five had between six and twelve months off duty, and nine between two and six months. Of the remaining sixty the great majority returned to a normal life after a period of one to three weeks. In many instances this inadequate convalescence was probably responsible in some measure for the breakdown which ultimately led to admission to sanatorium.

Aspiration in Pleurisy with Effusion.

Fluid should be removed early for cytological and bacteriological examination. Cultural examination is essential in most cases. A negative result should not, in so-called "idiopathic" pleurisy, be regarded as indicating a non-tuberculous ætiology if the result of the Mantoux test is positive. In moderate-sized effusions, as the more acute phase subsides, I usually withdraw 500 or 600 millilitres of fluid, in larger effusions more. I then introduce 200 or 300 millilitres of air. A radiograph is taken. Any pulmonary involvement is as a rule more manifest after this procedure. If a parenchymatous lesion is visible on the X-ray film, it is probably advisable to maintain the pneumothorax if it is not already too restricted by adhesions. In other cases any further interference with the fluid is conditioned by the patient's symptoms and any evidence of circulatory or respiratory embarrassment. Removal of fluid persisting after defervescence will minimize the tendency to thickened pleura, which later may interfere with respiratory function.

Some clinical observers believe that too frequent aspiration, with the introduction of air, may sometimes predispose to tuberculous empyema. The tubercle bacillus, being aerobic, will multiply more rapidly in the presence of air.

TUBERCULOSIS IN HOSPITAL PERSONNEL.

Personal contact with consumptives was known to be dangerous, even in the days of Hippocrates and Galen. Case-finding investigations in all countries have revealed the dominant role played by contact, especially in household infection. Such contact, also, has been shown to be an important factor in the incidence of tuberculous infection among hospital personnel.

Incidence.

Incidence has been most exhaustively studied in the United States of America. Most interesting figures were recently published by Childress,[7] dealing with the Grasslands Hospital in New York State. This is an 800-bed general hospital with a special division of 300 beds for tuberculosis. X-ray observations began in 1932. Members of the staff were submitted to X-ray examination every six to twelve months, depending on the intimacy of the contact. A much higher morbidity was found among those exposed. Seventy-four of the exposed group of 2,092 persons, or 3·5%, developed disease or had disease which was reactivated. Sixteen of the non-exposed group of 2,947 persons, or 0·54%, developed disease or had disease which was reactivated. (Non-exposure was interpreted as not exposed to known sources of infection, except as met with in a general hospital.) Of those with active disease, 82% could be traced to known sources of infection. The average length of exposure for those previously healthy who developed disease, was twenty-one months, compared with eleven months for those exposed, who remained well. Childress states that "Baldwin's observations that the number and frequency of implantations of the bacilli are important factors in the danger of tuberculous infection in hospitals and sanatoria seems to be borne out by the evidence". He further states that experience at Grasslands supports the view that exposure to tuberculosis is an occupational hazard.

The higher incidence of clinical tuberculosis among hospital personnel, as compared with similar age and sex groups in the population, has been supported by the findings of many American and Scandinavian observers.[8] [9] [10] [11] [12] [13]

Daniels,[14] investigating the literature from 1933 to 1941, found an incidence of 2·1% of cases of tuberculosis among 8,602 nurses who initially gave positive tuberculosis reactions, as compared with 5·8% among 4,832 who began training after having failed to react. In his Prophit survey, he found in England an annual case rate per 1,000 of 7·4 for the positive reactors on entry as compared with 18·8 for those who initially did not react. The case incidence for both groups was 2·7 for 2,572 nurses. Among those who failed to react the interval between the first infection and the development of the disease was usually less than twelve months. A minority of nurses do not develop frank disease until some years after primary infection. Daniels states: "The relatively high incidence of tuberculosis following primary infection in young adults is probably not generally appreciated because of the absence of characteristic primary lesions."

At the New York Hospital the incidence of tuberculosis over seven years among the nurses was only one-fourth of the rate for females of a similar age and social group and one-third of that for medical students at the same hospital. This exceptional situation was attributed largely to the extremely good living conditions of the nurses.[15]

Most authors have emphasized that, though the incidence of the disease is higher among nurses than among other young women, the prognosis is usually very much better. This is due to early diagnosis and adequate treatment. The mortality rate among nurses is lower than the general female rate. Daniels confirmed this, the annual death rate in the nurses investigated being only 0·27 per 1,000. The rate for all females, aged fifteen to twenty-four years, in England and Wales was 0·76‰ in 1938 and 0·84‰ in 1940.

Investigation of medical students and resident medical officers has not been so exhaustive. There are, however, several American publications which indicate a higher incidence of tuberculosis among medical students than

among students in other faculties and persons of similar age and social groups.

Alt and others[16] found that among 700 students who had completed the medical course at North Western University, "clinical tuberculosis developed in 1% and an additional 1·7% developed latent pulmonary lesions". This is lower than the incidence in Philadelphia of 2% and 3% respectively, as reported by Hetherington and others.[3] Several authors have mentioned the occurrence of lesions as a result of laboratory and autopsy room infections, due to accident or careless technique. I have had as a patient a pathologist with tuberculous lymph nodal involvement following an accidental puncture wound of the finger. Shortly after I completed my term as house physician at the Brompton Hospital in 1923, the bacteriologist, the technician and the "lab. boy" all developed the disease in a serious form within a few months. As Alt and his colleagues point out, cross infection among hospital workers is always a possibility.

It has been found that the incidence of infection among hospital personnel varies to some extent in different institutions. Among the factors which influence this rate are the type of patient treated, the living and working conditions of the staff, and the climate. In wards or institutions for patients in the advanced stages, especially for those with severe cough and general debility, the infective potentialities are greatly increased. If the climate is sufficiently temperate to allow patients to live in open wards day and night all the year round, the risks to the staff are very slight.

Prevention.

Among the methods advocated by Oatway[17] and others are the following:

1. Recognition of all tuberculous persons treated at hospital. This means compulsory radiological examination of the chest of every attending or admitted patient. (An X-ray survey of newly admitted patients in general hospitals in several American States before the war showed that from 1% to 4% were tuberculous. Two-thirds of these patients were unaware of this. Such patients without X-ray examination of the chest are a menace to the staffs of hospitals and especially to the nurse.)

2. Segregation of all tuberculous patients while in hospital.

3. Instruction of these patients in hygienic habits to prevent dissemination of infection. Patients with poor control over cough are often masked in Canada and the United States of America, while the nurse is giving attention. Patients vary greatly as regards cooperation in preventive measures. A survey was conducted in one American institution unknown to the patients. Fewer than 15% were found to be consistently conscientious in the carrying out of all hygienic instructions.

4. Provision of paper handkerchiefs, sputum cups *et cetera*.

5. Frequent changes of patients' linen. Utensils and toilet equipment should be sterilized after use.

6. Impregnation of blankets of all tuberculous and other infective patients with a weak emulsion of paraffin, and oiling of floors with spindle oil. Damp dusting only should be allowed. (These measures are designed to diminish infection through dust.)

7. Protection of the nurse is also achieved by: (*a*) regular medical examinations, (*b*) instruction in tuberculosis, (*c*) vaccination with "B.C.G." of all trainees who do not react to tuberculin, (*d*) adoption of so-called "protective" technique at the bedside, (*e*) improved living and working conditions, (*f*) selection of positive tuberculin reactors over twenty-five years of age for nursing in tuberculosis wards.

Regular Medical Examinations.—It is a routine measure now in most training schools for the nurse to have her chest examined by X rays when she applies to enter the hospital. From time to time unsuspected active tuberculosis is discovered. After acceptance, each nurse should be tested by tuberculin (Mantoux).

The Mantoux test is carried out with dilutions, first with 1 in 10,000 and finishing with 1 in 100 if there is no reaction to weaker dosage. Parke, Davis and Company's "P.P.D." tuberculin is a more refined product than old tuberculin and may be used in its place. There are two strengths.

Those nurses who begin with a positive reaction should have the chest examined by X rays every six months while they are working as trainees or staff nurses.

Nurses who do not react should, in general hospitals, be retested every four months. Before these non-reactors begin ward duty, a further X-ray film of the chest should be taken in the right lateral position, in case this is needed for comparison later. Enlargement of the mediastinal glands can occasionally be demonstrated only by a lateral film. Such evident enlargement accompanies conversion of the tuberculin reaction in a very small proportion of cases.

In the further handling of these persons I have advised the following.

When the tuberculin test yields a positive reaction, postero-anterior and right lateral films are taken, the blood sedimentation rate is estimated, and a differential and total leucocyte count is done. In doubtful cases tomography may be helpful. The nurse should not look after tuberculous patients for at least one year. She should be advised to avoid strenuous exercise and prolonged exposure to the hot sun for a period of at least six months. She should also be recommended to have an adequate intake of protective foods and to avoid late nights *et cetera*.

If any change is noted on the films, she should be taken off duty for a variable period, from one month or more, depending on subsequent course of events. Radiographs should be taken every four to six weeks for at least six months. Fasting gastric contents should be examined by culture methods.

If there are no radiological changes, but the blood sedimentation rate is disturbed, she should be recommended for a rest for a month or longer, or put on half-time duties until a normal reading is obtained.

With regard to those girls who show no radiological changes and no alteration of blood sedimentation rate, they should be subjected to radiological examination again (postero-anterior and lateral films) two months after the conversion of the tuberculin reaction. Further X-ray films should be taken three months later, the chest being radiographed at least four times during the first twelve months after the positive tuberculin result.

In nurses who subsequently develop reinfection type lesions, early artificial pneumothorax is favoured in the great majority of cases, even in the absence of evident cavitation or positive sputum.

Instruction in Tuberculosis.—Instruction in tuberculosis will provide the nurse with the information enabling her to minimize risk of infection.

Vaccination with Bacille Calmette Guérin.—"B.C.G." vaccination of nursing trainees who do not react to tuberculin has been found in Norway, Sweden and Canada to be of definite value in the prevention of active disease. Effect lasts for one to several years. The figures published by Hansen[18] of the results in Norway provide striking evidence of the value of the method. By vaccination the morbidity seemed to have been reduced to one-seventh. It is possible that the Vole bacillus may be preferable as an antigenic agent. Experiments with this organism were most hopeful. They were interrupted by the death of Stanley Griffiths and the war.

The Protective Technique.—The "protective technique", properly carried out, is extremely important at the bedside of the tuberculous patient. Even if this does not entirely eliminate infection, it reduces dosage. This involves the use of gowns, masks, head-covering and frequent handwashing. Care must be exercised in the employment of hair covers, masks and gowns so that they are used efficiently. They must also be changed frequently. There should be an ample supply (clean) of these articles. Frequent handwashing with thorough lathering cannot be too strongly insisted on. "The keynote of protective technique is in fact scrupulous cleanliness."

Improved Living and Working Conditions.—Good food containing adequate vitamins and mineral salts, good living quarters, adequate recreational leisure and avoidance of overwork are all factors which help to maintain a high resistance against infection. The trainee should also restrict late nights and social activities likely to cause lowering of resistance through loss of sleep.

To deal with the problem of infection, the Tuberculosis Committee of the American Student Health Association has advised that all first-year students be tested with tuberculin and the positive reactors be examined radiologically every year. Those who fail to react should be retested every six months, and then closely followed by serial radiographs (three-monthly for the first year), when the result of the test becomes positive. Blood assessment may give additional help in some cases.

The appointment at each large hospital of a small committee (medical, nursing and administrative) to formulate and to administer a programme of tuberculosis control and prevention among the staff would be most helpful.

Monetary compensation for those invalided temporarily or permanently from the disease as a result of occupational contact is essential. Compensation laws to include such cases have been enacted in nine American States, the territories of Hawaii and the Philippines (when under American control).

The Course and Treatment of "Minimal" Tuberculous Disease of the Lungs.

With the increased use of fluorography this subject has assumed greater importance. The cases which require the closest supervision are those in which radiologically the lesions are not obviously fibrotic or calcified. The commonest lesions met with are exudative in character, and take the form of a lobular bronchopneumonia. They are usually subapical, but may be located anywhere. They are oval or round homogeneous shadows, usually between 0·5 and 3·0 centimetres in diameter. Sometimes there are multiple tiny foci usually in clusters near the apex. These usually show a fibrosing tendency. Exudative lesions are unstable in behaviour, especially in younger patients. Breakdown and spread can occur most insidiously, particularly in the second and third decades of life. Brauening, quoted by Amberson,[19] estimates that not more than 20% of these minimal exudative lesions run a relatively benign course without treatment. Zachs[20] states that: "In the second decade of life the prognosis for soft early lesions is uncertain for at least ten years. In individual cases most important in prognosis is the behaviour of the lesion according to serial X-ray film." Amberson,[19] too, emphasizes that, even if on radiological examination the lesion appears relatively unchanged for months, or for a year or two, one must not assume that it is stabilized. Progression may occur after even a few years of latency. Margaret Macpherson,[21] from her observations over several years at the Brompton Hospital, stated: "Relative to pulmonary tuberculosis in childhood and even to tuberculous meningitis in childhood, pulmonary tuberculosis in adolescence and early adult life is a greater menace to the population." She found that, when some children, who had been under observation for childhood infection, reached adolescence, usually between fifteen and nineteen, "adult types of lesion begin to appear". They were usually asymptomatic. In some instances the sedimentation rate was normal. Untreated, the lesions alternated between periods of activity and periods of apparent quiescence, nearly always with a tendency to spread. Few healed spontaneously. "The period of time between the first appearance of the lesion in the X-ray film and the first symptoms varied from between three and five years."

Treatment.

Amberson,[19] dealing with a favourable clinical material, mostly nurses, medical students and similar hospital personnel, advises bed rest for three to six months. Pneumothorax was induced if the lesion showed signs of progression. Most of his patients were able to return to light employment at the end of a year. Of the cases, 5% were fatal, in spite of treatment. Some other American authors strongly advise prolonged bed rest for these patients in preference to pneumothorax, except in the presence of cavitation. Zachs,[20] dealing with tuberculosis in the second decade of life, found that "bed rest alone for shorter or longer periods, judged by the ten year standard (of survival), has failed utterly to influence the course of the disease. This applied both to advanced and to progressive minimal cases". He concluded that "lesions that retrogressed, as shown by X-rays, did well with bed rest, as they usually do without any treatment at all". Zachs's extensive experience in this field has led him to advocate the induction of pneumothorax immediately in all cavity cases and after one or two months' bed rest in subclavicular infiltration which is not definitely retrogressing. He waits three to six months in the case of non-excavated apical lesions before inducing pneumothorax.

Wingfield, who has had an enormous experience, and Macpherson[21] advise early induction of pneumothorax in symptomless adolescent pulmonary tuberculosis. They point out that in adolescence "it is folly to continue observation without treatment in the hope that the case in point may be the exception which proves the rule". The very great majority of patients are for economic reasons unable to undergo a long period of bed rest followed by a gradually increasing activity and years of sheltered living. The authors therefore advocate a short stay in a hospital or sanatorium, with induction of pneumothorax, and maintenance of a small degree of collapse for two or three years. "If the infiltration is bilateral, the position is unaltered, and the treatment is the same. A shallow bilateral pneumothorax is tolerated as easily as a unilateral one. . . . Regular supervision is ensured by the weekly attendance for refills." They conclude: "Here then is a form of treatment which offers a reasonable prospect of cure without prolonged exile from normal life and work."

My experience leads me to support this advice. I have never regretted inducing a pneumothorax in minimal disease, but have on several occasions regretted that I had not done so earlier. But, while treating the lesion, we must not forget the tuberculous patient and must do all we can to build up resistance, so that sound healing will, if possible, be ensured.

The great majority of clinicians today advise collapse therapy in minimal disease in patients under thirty years of age when there is X-ray evidence of the lesion breaking down, or when positive results are obtained on examination of the sputum or cultural examination of gastric contents after a period of conservative treatment. In patients over thirty consideration of collapse is not as a rule so urgent from the pathological point of view. Nevertheless the induction of pneumothorax usually provides an additional safeguard against future relapse. I feel that the treatment should almost invariably be given in minimal disease even to patients over thirty years of age if the patient's heredity, temperament or economic status is likely to have an unfavourable influence on resistance. The treatment should, however, always be given if possible in a sanatorium.

Present-Day Institutional Treatment.

This brings us to a discussion of present-day institutional treatment.

Marked changes have taken place during the last twenty years in the requirements of the tuberculous patient. This evolution has resulted in the creation of institutions quite different from the sanatoria of twenty-five years or so ago. These were little more than rest homes in the country. As a result of the demands of (*a*) present-day treatment, (*b*) rehabilitation and (*c*) teaching in tuberculosis, the modern sanatorium is more like a general hospital for the active care of patients with chronic disease. Further, such activities can be carried out most efficiently and economically in large institutions. I have dealt with the many advantages of such institutions in a previous paper,[22] and in several memoranda. I shall therefore now discuss the present-day treatment of the disease.

Modern Treatment.

As a general rule, one can say that, wherever the disease is localized, the soundest basis of sanatorium treatment is general rest, until quiescence has been attained. In those cases without marked toxæmia and in which the disease remains active in spite of treatment, rest is continued only until the maximum benefit has been achieved.

The earlier pioneers of sanatorium treatment, George Bodington in England, Brehmer and Dettweiler in Germany, did not appreciate the importance of long-continued bed rest in pulmonary tuberculosis. In Britain for many years, patients with "surgical" tuberculosis were kept at rest until the disease was quiescent. Yet graduated exercise was prescribed early in the same disease with pulmonary manifestations. This traditional attitude to patients with phthisis appears first to have been queried in England in the early 1920's by two outstanding tuberculosis specialists, Clive Riviere and Claude Lillingston. They had both been impressed by reports from the United States of America (especially Massachussets and New York State) and from Canada. Lillingston, writing in *The Lancet* of January 13, 1923, stated that "the doctrine of graduated exercise owes its popularity to (*a*) the vigorous and charming personality of its chief sponsor (Marcus Patterson), (*b*) the primitive instincts of a race whose strength has never been to sit still, and (*c*) a minute kernel of truth".

He continued:

> Success achieved by the silence treatment of tuberculosis of the larynx, by artificial pneumothorax and thoracoplastic operations, have done much to prove that immobilization is quite as essential to the tuberculous lung as to the tuberculous joint. Ungraduated rest rather than graduated exercise is the patients' need when the disease is incipient and active.

Riviere, impressed by the results achieved in Boston by Pratt[33] and by Archibald and others in Montreal, recommended in 1923 prolonged bed rest in the patient's home. He stressed the view that prolonged rest was based on safe lines and sound principles which had worked in practice. He published in the *British Medical Journal*[34] a table showing the after-results of treatment under a system of graduated work, of graduated exercise and of rest. This table reproduced by Pratt[33] is as follows:

Riviere's Tabulation.

Years After Discharge.	Frimley Cases at Work. Percentage.	Midhurst. All Cases Tuberculosis and "Well or Alive". Percentage.	Pratt's Unselected Cases (191 altogether at Work). Percentage.
1	61	69	95
2	50	61	92
3	46	50	87
4	44	47	76
5	39	39	71
6	42	38	69
7	23	38	70
8	—	33	70
9	—	38	64
10	—	35	50

Pratt's figures later showed 79% well and working after ten years, a better record than the Frimley or the Midhurst cases after one year.

Lillingston and Riviere's advice, however, was largely ignored in British sanatorium practice. Further, British text-books continued to stress graduated exercise based on temperature and pulse records as the main feature of sanatorium treatment. As Pratt[33] says:

> The resistance to the adoption of rest treatment has been much greater in Great Britain than in this country (U.S.A.). There, treatment by graduated exercise sponsored by Marcus Patterson of Frimley, was held in favour for many years in spite of very poor end results.

In the meantime, rest, which had been advocated in the 1890's by Edward L. Trudeau at Saranac Lake, and which was first applied systematically in the United States of America in 1900, became the solid basis of treatment over most of North America, including Canada, early in the 1920's. It was also used in some Continental centres, notably in the Alps. At Leysin, Switzerland, in 1924, I first saw the splendid results obtained by Dr. Marc Jaquerod by prolonged rest in advanced pulmonary cases. (He reported some of these in an article[35] in 1935.) Soon afterwards, on beginning work as a sanatorium physician, I realized that exercise, following defervescence, as advocated in the English text-books, usually meant "the survival of the fittest". Further, I became convinced that it often tipped the balance unfavourably in border-line cases, in which the patients might have been saved by prolonged rest.

In the 1930's some British tuberculosis specialists, impressed by what they had seen in Canada, United States of America, and those Continental centres where prolonged rest was practised, turned to the teachings of Clive Riviere and the American school. By the middle 1930's a change began to take place in some British sanatoria. Two important books published just before the outbreak of war—Kayne, Pagel and O'Shaughnessy's "Text Book on Pulmonary Tuberculosis"[36] and Dunlop, Davidson and McNee's "Text Book of Medical Treatment"[37]—have abandoned traditional British teaching regarding treatment by early exercise.

Adequate bed rest, long after defervescence, may in some advanced cases bring about such an improvement that the patient, previously unsuitable for collapse therapy, can be submitted to such treatment without undue risk. Bed rest, as Price Thomas[38] points out, acts like collapse in "decreasing the flow of toxic lymph from the diseased area". It also "results in shallower respiration with diminished excursion of the chest wall". This has the effect of diminishing the "inspiratory tug" on the draining bronchus of any cavity which may be present. But as Price Thomas says, bed rest should be complete, though not absolute. "Eighteen hours in bed with six hours up is no method for producing cavity closure, as although bronchial occlusion may occur during rest, the active exercise will re-establish a by pass valve and inflation of the cavity will recommence."

Corylios[39] was, I believe, the first to stress the importance of rest in favouring occlusion of the draining bronchus, and, therefore, closure of the cavity. He explained this action as due to a decrease in the amount of tidal air and respiratory excursion consequent on a decrease of the metabolic needs of the body for oxygen.

Absolute rest is needed only for a very few toxic patients. The great majority of patients, while on bed rest, actually begin their rehabilitation by some form of occupational, educational or vocational therapy.

With a large percentage of sanatorium patients not leaving their beds except possibly for toilet purposes, sanatorium treatment needs quite a different approach from the architectural and administrative points of view. This approach has further to be modified by the use of collapse therapy in 50% to 80% of cases of reinfection type pulmonary tuberculosis.

Collapse Therapy.

I have dealt with collapse therapy at length in another paper. This form of treatment has undergone marked evolution during the last twenty-five years. This has, I think, been brought about by several factors, among the most important of which are:

1. Improved radiological equipment and technique, especially the introduction of the rotating anode tube and of tomography.

2. Improved methods of growing the tubercle bacillus, and the examination of fasting gastric contents when sputum is unobtainable.

3. The development in the early 1930's of improved thoracoscopes, resulting in a greatly increased use of internal pneumolysis. The practice of adhesion section during the first two to six weeks in from 40% to 70% of pneumothorax cases has had the effect of markedly improving the results of this treatment.

4. The appreciation that relaxation of lung, and not compression, should be the basis of collapse therapy.

5. The development of the modern partial paravertebral thoracoplasty, and of the Semb technique of freeing the lung apex from all its attachments in the neck.

6. The use of temporary paralysis of the phrenic nerve, and the more restricted employment of such an irrevocable procedure as phrenic evulsion. Phrenic paralysis is probably most helpful in association with artificial pneumothorax.

7. The use of bilateral collapse measures.

8. The realization of the vital role played by occlusion of the draining bronchus in the healing of cavities.

9. The use of bronchoscopy in suspected cases of tuberculous tracheobronchitis. The recognition of this occasional complication is especially important in collapse therapy.

10. The more recent introduction of pulmonary resection in a very limited number of cases.

11. The use of physiological tests for estimating, before any major irrevocable thoracic surgery, the functional efficiency of the circulatory and respiratory systems.

Cardio-Respiratory Tests.

Cardio-respiratory tests owe their clinical application largely to Gaubatz, of Heidelberg,[30] and to Cournand and his colleagues[31][32] at the Bellevue Hospital, New York. They represent an attempt to estimate the function of the various components of the body which take part in respiration. These components and their functions are (i) the chest wall and elasticity of the lung—ventilation, (ii) the bronchial tree and air passages—the distribution of air, (iii) the alveoli—diffusion, (iv) the pulmonary capillaries—perfusion, (v) the blood—transport of gases, (vi) the heart and arterial tree—cardiac output and distribution of blood, (vii) the venous system and pulmonary vascular bed—venous return flow, and (viii) the tissues—metabolism and energy exchange.

It is now generally agreed that the usual estimation of the vital capacity is not a reliable indicator of the ventilatory capacity. Further, this cannot be accurately predicted from the amount of uninvolved lung seen in postero-anterior X-ray films in advanced disease.

Harden and others[33] found that "the values which predict latent ventilatory insufficiency most accurately are the maximum breathing capacity, minute volume respiration, and the breathing reserve". The maximum breathing capacity is the maximum volume of air ventilated in a unit of time on forced breathing. The second factor is the amount of air ventilated (that is, the number of litres) per minute per square metre of body surface under resting conditions. The breathing reserve is the difference between the two first factors expressed as a percentage of the maximum breathing capacity.

In ventilatory insufficiency there is a decrease in breathing reserve. When marked, this is manifest clinically by dyspnœa. Respiratory insufficiency, on the other hand, is accompanied by a decrease in the removal of oxygen from the inspired air, and by a diminution in the elimination of carbon dioxide from the expired air. A decreased ability to absorb oxygen with little reduction in vital capacity and a paucity of radiological signs is not infrequently met following pleurisy and the reexpansion of pneumothorax.

In some cases bronchospirometry is indicated to determine the function of each lung independently of the other. This is now done by means of bronchial catheterization instead of by the more difficult method with a special bronchoscope introduced by Bjorkmann, of Stockholm.[34] Major Paul Gebauer, recently in Melbourne with the Fourth United States General Hospital, was responsible for this advance.[35] His special catheter has been modified by Zavod,[36] also of the United States of America.

The efficiency of the heart and circulation is assessed by the usual clinical tests and by electrocardiography, together with measurements of the blood pressure, the venous pressure, and circulation time. The efficiency of the right side of the heart is especially investigated by estimating the venous pressure before and after the rapid intravenous infusion of 1,500 cubic centimetres of normal saline solution. Similarly circulation time and ventilatory tests can be carried out before and after rapid intravenous infusion.

There is in Australia a big field for the development of these methods. They are of practical value in thoracic surgery in (i) the choice of cases, (ii) the planning of operation stages in thoracoplasty, (iii) the planning of post-operative care, (iv) the forecasting of results, and (v) the estimation of the "ultimate physical capacity".

Gaubatz, Cournand, Ruttgers and Smilovits[37] are among those authors who have reported significant diminution in pulmonary function following diaphragmatic paralysis. Such reports confirm the desirability of avoiding permanent paralysis by evulsion unless this is very definitely indicated.

Rehabilitation.

Rehabilitation, according to the American National Council on Rehabilitation,[38] "is the restoration of the handicapped to the fullest physical, mental, social, vocational and economic usefulness of which they are capable". In the modern sanatorium, as I have described in a previous paper,[39] rehabilitation includes every form of education from kindergarten to the university, also, so-called "adult" education, as well as occupational therapy, vocational training and selective placement. Much of this is still undertaken while the patients are at rest or on very restricted activities. Soon after admission to hospital the patients are medically assessed as to the amount and nature of permissible activities. The rehabilitation staff investigates their aptitudes, requirements and possibilities of future occupation. A plan is thus established. This may be modified, after consultation between the medical and rehabilitation staff, according to changes in the patient's condition. A complete rehabilitation scheme can be carried out most efficiently in large sanatoria of at least four or five hundred beds or larger. This permits of a greater variety of subjects to be covered.

E. M. Brieger, of Papworth Village Settlement,[40] has discussed the method used at Papworth in classifying patients as to (*a*) "their prognosis of stability" and (*b*) "their degree of physical efficiency". The follow-up statistics at Papworth have permitted a classification of ex-patients "according to anticipated stability in terms of life expectancy". The factors utilized are (*a*) the presence of tubercle bacilli in the sputum or sputum conversion, (*b*) the presence of cavities, their size, number and character, (*c*) the blood sedimentation rate, (*d*) the presence of complications. Patients with arrested infections are regarded as fully employable. Non-infectious convalescent patients require controlled employment (part time and medically adjusted). In chronic active cases the patients need sheltered employment, part time, in special workshops.

The circulatory and respiratory efficiency is tested under resting conditions, and then while the patient is expending energy on the ergometer at various loads. The results obtained are compared with the values found in healthy persons of average physical fitness. A system of marks is arranged so that the patient's physical efficiency may be classified as (*a*) very good, (*b*) fairly good, (*c*) poor, and (*d*) very poor.

Brieger is convinced that "by taking an average of the values representing stability and physical efficiency a fair picture of a patient's employability can be obtained". Berger considers that the use of acceptable standards to express a patient's working capacity would be of definite practical value in rehabilitation. This capacity would be expressed in the terms of "target hours". Observation of the individual case, to allow of modifications, would still be necessary.

The Teaching of Tuberculosis.

Although tuberculosis is still the most important disease causing death in young adults, it is relatively neglected in the teaching curricula of our universities. Student instruction in this disease badly needs reorganization, and post-graduate study will have to be encouraged. Such teaching can most effectively be carried out in large hospital sanatoria for the investigation and treatment of

the disease in all its manifestations and stages, and at all ages. Similarly, for the student and post-graduate instruction of nurses such institutions have many advantages.

The understanding which the general practitioner has of the fundamental facts of the disease and the extent of his cooperation with the public health authorities are obviously of great practical importance. On this will depend not only the fate of numerous individual patients, but also the prevention of the spread of infection.

Some of the facts which appear to me to need more widespread appreciation are:

1. The inability of physical examination to detect early disease, or to assess the extent of involvement in advanced disease. Even if students must learn, for examination purposes, the obvious signs associated with gross pathological changes in the chest, the great limitations of the stethoscope in early diagnosis need constantly to be stressed. In tuberculosis I would go so far as to say that the stethoscope is a dangerous instrument, as its use so frequently leads to erroneous conclusions.

2. The danger of household infection.

3. The value of the intradermal or patch tuberculin test in suspected or contact children, adolescents and young adults, especially those with a rural background.

4. The significance of pleurisy in the young and in early adult life.

5. The possibility of a tuberculous ætiology in some cases of "chronic bronchitis" in older patients.

6. The necessity to have the chest investigated by X rays in all cases of *fistula-in-ano*.

7. The modern sanatorium treatment and rehabilitation of tuberculous patients. Only with a good first-hand knowledge of such conditions can the practitioner give adequate and satisfactory advice to his patients. To obtain this knowledge, at least one dozen half-days should be spent by final year students at the sanatoria. This time could be taken from that allotted to practical instruction in medicine and surgery. Resident interneships for one or two months should also be available for some senior students.

SUMMARY.

In a discussion of the care of patients with post-primary manifestation of tuberculosis, the necessity of adequate and repeated radiological investigation is stressed. The importance of the Mantoux test and of the cultural examination of the fasting gastric contents is referred to. It is suggested that a special form of notification should be adopted in these cases. The unsatisfactorily low rate of notifications of tuberculosis in Victoria is compared with those of other States and countries. Reference is made to blood assessment in the control of rest. A sufficiently long period of convalescence is advocated.

As regards the incidence of tuberculosis in hospital personnel, the view that exposure to this disease is an occupational hazard is supported. Figures are quoted which demonstrate the greater susceptibility of those who enter hospital as non-reactors to tuberculin. Methods which should be used in prevention are outlined.

The instability of the great majority of minimal lesions in younger patients is stressed. A period of sanatorium treatment, combined with early artificial pneumothorax, is favoured as treatment.

The marked changes which have taken place during the past twenty years in the institutional treatment of tuberculosis are discussed. The advantages of prolonged rest treatment are emphasized. Some of the factors which have modified the evolution of collapse therapy are mentioned. The use and value of cardio-respiratory tests are the subject of comment.

In regard to rehabilitation, the methods developed at Papworth to assess the patients' physical fitness for work are referred to.

Finally, essential reforms in the teaching of tuberculosis are advocated.

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THE TUBERCULOUS LUNG CAVITY AND MONALDI'S CLOSED SUCTION DRAINAGE.[1]

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The Mechanism of Cavity Formation and Maintenance.

DURING the 1930's a radical change took place in our views regarding cavity formation and healing. The part played by destruction has been more accurately assessed and a truer significance attached to mechanical factors. Among those principally responsible for these changed concepts were the late Pol N. Coryllos, of New York,[31] Leo Eloesser, of San Francisco,[32] and Morelli and Monaldi,[33][34] of Rome. Salkin, Cadden and McIndoe[35] also made some interesting contributions. More recently Price Thomas, of London,[36] has emphasized the important role, first stressed by Coryllos in 1932,[37] of occlusion of the draining bronchus in cavity closure.

In 1932 Coryllos explained the failure of a tuberculous lung cavity to collapse, after evacuation of a liquefied caseous area, by the presence of air in the lung and by the difference in pressure between the intrabronchial air and the intrapleural space.

Monaldi[34] taught that only a few chronic cavities owe their size to the destruction of an equivalent area of lung tissue. In the very great majority of cases mechanical factors determine the behaviour of a cavity resulting from an ulcerative lesion of the lungs. Monaldi divided these factors into extracavitary and intracavitary. As regards the extracavitary factor, he pointed out that when ulceration results from liquefaction of a lesion, this is immediately influenced by the permanent state of distension existing in the lung, and by the traction of the chest wall and diaphragm on inspiration. Price Thomas[36] believes that such traction is important only when the cavity is adherent to the chest wall or diaphragm.

All are, however, agreed on the important role played by the draining bronchi in the behaviour of the cavity. These may be single or multiple, small or large, long and tortuous, or short and straight. Coryllos appears to have been the first to emphasize the significant part played by the bronchial connexions. He showed that bronchial lesions were a constant finding in tuberculous cavities, as described in 1885 by Grancher, Rindfleisch and Rokitansky,[38] and quoted by Coryllos.[31] He further pointed out how changes in the lumen of the draining bronchus influence the evolution of cavities. These changes may be in the nature of mucosal swelling due to hypersensitivity to tuberculoprotein, or they may be infiltrative, ulcerative or fibrotic. Very occasionally enlargement of the lumen of the draining bronchus may result from caseation. Most frequently narrowing and obstruction occur. There is also occasional blocking from secretions.

During expiration, when the bronchi normally contract and narrow, the lumen of the affected bronchus becomes still smaller. The Chevalier Jacksons[39] were among the first to show that bronchial inflammation and ulceration tended towards a stop-valve effect distal to the inflammation. The bronchial involvement may prevent completely the egress of air during expiration. A cavity with such a bronchial outlet will tend to increase in size and remain ballooned. If the bronchus becomes patent the cavity will revert to its normal size. If obstruction becomes complete, there is a twofold effect. Asphyxiation of the tubercle bacilli results, as they are strict aerobes. Further, as the gas in the cavity is absorbed, the cavity space will shrink and finally disappear. If the draining bronchus reopens, the cavity will reappear.

With incomplete obstruction the cavity tends to persist. Monaldi has pointed out that the lung tissue round the cavity becomes compressed during expiration between the raised intracavitary pressure and the increased pressure in the surrounding lung. As a result of this compression a ring of airless or atelectatic tissue is formed. If the cavity persists, pericavitary fibrosis takes place and the wall becomes increasingly rigid. Very few cavities, however, become completely undeformable.

Not infrequently, according to Maxwell and Konstam,[40] the check-valve effect is replaced by a two-way by-pass valve effect. Air then escapes from the cavity during part of inspiration. Very occasionally cavities are found to contain air under negative pressure. This is due to a deflationary check-valve mechanism from partial bronchial obstruction. Air escapes more easily than it can enter owing to the nature of this obstruction. When the bronchial outlet remains open during both expiration and inspiration, the cavity pressure is atmospheric. Price Thomas[36] considers this is the usual situation in the later stages of cavity development, and that the cavity then remains open on account of the "pull of the chest wall".

Healing of Cavities.

Most tuberculosis clinicians today accept Coryllos's views that healing of lung cavities depends almost invariably on occlusion of the bronchial outlet. This occlusion may occur at the cavity outlet or in the bronchus. This mechanism is responsible, whatever the method of treatment employed. Bed rest, like pneumothorax, diaphragmatic paralysis and thoracoplasty, acts by diminishing the "inspiratory tug" (Price Thomas) of the draining bronchus. The relaxation, induced by general and local rest, thus plays a vital role in the healing of cavities. During investigations of a large post-mortem material extending over eight years, Auerbach,[41] of the New York Sea-View Hospital, was able to find only one example of cavity healing due to fibrous transformation of the wall. In 134 autopsies in thoracoplasty cases he found 17 in which closed cavities were present. In each of these the draining bronchi were closed. When the cavities were open, the draining bronchi were patent.

Occlusion of the bronchi was effected by pericavitary and peribronchial fibrosis and sometimes by intrabronchial fibrosis. In the post-mortem examination of over two thousand tuberculous cavities Auerbach and Green[42] found a bronchial communication in every open cavity of three centimetres or more in diameter. They also found that the draining bronchus almost invariably showed the same tuberculous process as the cavity. The relationship of the bronchus to the cavity thus plays an important role not only in the ætiology of the cavity, but also in its maintenance and closure. Investigation of this relationship is desirable in many cases among patients submitted for thoracoplasty or for suction drainage.

The Cavity-Bronchus Relationship.

The cavity-bronchus relationship may be studied by the following:

1. Needling of the cavity and observation of the pressures, with and without the introduction of air.

2. Serial X-ray examination. The changes in size which may accompany partial bronchial obstruction can thus be noted.

[1] This article formed the basis of a paper read at a meeting of the Royal Australasian College of Physicians at Melbourne on September 23, 1944.

3. Analysis of cavity air, as practised by Coryllos.[11] Oxygen percentages increase and carbon dioxide decreases with increasing patency of the draining bronchi.

4. Ascending bronchography and cavernography to outline the draining bronchi and the cavity. Cavities with one or two draining bronchi have usually developed mostly from mechanical causes. Numerous draining bronchi or one large lobar bronchus indicates that tissue destruction has played a major part in cavity formation.

5. Cavernoscopy, as carried out by Coryllos, Price Thomas and others.

I have discussed this matter at some length, as a knowledge of the newer concepts of cavity pathology is essential to a clear understanding of the modern attitude to the treatment of pulmonary tuberculosis.

Monaldi's Closed Intracavitary Suction Drainage.

Closed intracavitary suction drainage, of course, is not "collapse therapy". I intend to deal with the method at much greater length than its therapeutic importance at present warrants, as I believe that it is not very well known in Australia.

History.

Open drainage of lung cavities has been carried out in isolated cases for centuries, and has recently come more into favour. Closed suction drainage was first tried in 1937 by Eloesser, of San Francisco. Trials with four patients were not satisfactory. For some years Morelli and Monaldi, of the Forlanini Institute, Rome, had been convinced of the importance of the mechanical factor in the maintenance of tuberculous cavities. In August, 1938, Bottari, Monaldi's chief assistant, made the first clinical trial of closed suction drainage. The patient, who had had a cavity for four years, responded dramatically. Her cavity had not reopened eighteen months later when I was in Rome. Other successes followed. As a result the method was tried more extensively. I saw it first used in Switzerland in May, 1939, and I witnessed several encouraging results. In April, 1940, I spent a week in Monaldi's clinic in Rome and reviewed many of his cases. This made me realize that a very interesting and probably useful therapeutic method had been introduced. The war has interfered with its trial on a scale sufficiently large to establish definitely its limitations. Its future usefulness would appear to depend on the introduction of a method to bring about closure of the draining bronchi.

Theoretical Basis.

We have discussed the physio-pathological principles on which the treatment is based in the discussion of the modern concepts of cavity formation.

The negative pressure of suction neutralizes the mechanical factors tending to keep the cavity open. Simultaneously the tuberculous lining of the cavity wall is removed; tubercle bacilli disappear from the cavity secretions and the sputum. There is some hyperæmia of the surrounding tissues with absorption of exudate, and healthy granulation tissue is formed in the previously ulcerated area. Healing takes place with the apposition of these clean walls. Such healing appears to be inevitable if the bronchial outlets of the cavity close.

Response to Treatment.

Theoretically one would expect cavities with negative pressures to respond most satisfactorily to suction drainage. I do not know of any large series of cases in which a study of pre-operative pressures has been correlated with response to treatment. My own experience has been too incomplete and limited. Maxwell and Konstam,[10] in a study of eleven cases, could not find any "constant relationship between the intracavitary pressures and the response to drainage". The presence of bronchial stenosis should theoretically favour obliteration of the bronchi and permanent healing of the cavity. Bronchial stenosis causing positive pressures may, however, in some cases lead to reinflation of the cavitated area on the cessation of suction. Monaldi claims that suction drainage will result in many cases in obliteration of the draining bronchus by setting up an obliterative endobronchitis. These views do not, however, command general assent.

Other Effects of Suction Drainage.

The removal of the toxic products and the diminution of cough usually result in an improvement in the general condition. Such improvement, together with the cessation of positive sputum, helps to bring about healing of lesions elsewhere in the lung and in the larynx and intestines, if they are not too far advanced.

Indications.

The indications for suction drainage may be set out as follows. It is assumed that in every case artificial pneumothorax is impossible or has, after trial, been abandoned.

1. Isolated thin-walled cavity with a diameter of at least one and a half inches and with a single bronchial outlet showing some stenosis, and no other pulmonary lesions. This is the ideal choice.

2. As a preliminary to thoracoplasty for "tension" and possibly in some large atmospheric pressure type cavities. Vineberg and Kunstler,[13] after an exhaustive study of cavity pressures in relation to response to treatment, advise suction drainage as a routine measure before thoracoplasty in all positive pressure cavities with a diameter of at least one inch. They claim that the great majority of cavities, even large ones, with free bronchial communications can be closed by thoracoplasty alone, whereas tension cavities, even though small, are likely to remain inflated, although their contour may be altered by the major operation. Experience suggests some support for this view. It would appear, however, that occasionally tension cavities may close following thoracoplasty, as a result of the relaxation's causing complete occlusion of the bronchial communications. In any case, it seems logical to consider the preliminary use of suction drainage in all large cavities, whether positive pressure is present or not, for which thoracoplasty appears indicated. For, not only is the cavity thus likely to be greatly reduced in size, but its tuberculous lining will probably be eliminated. The major operation will therefore be carried out with greater likelihood of complete anatomical success, and with much less risk of post-operative bronchial dissemination of the disease. In many of these cases the cavity, as a result of suction, will have been reduced to a fistulous track. If the bronchi remain patent, there is a risk of reinflation with the deeper breathing of an active life. Hence the desirability of thoracoplasty. In other cases, in which the cavity is fixed by pleurisy to the chest wall or in which pericavitary fibrosis prevents reexpansion of the atelectatic lung tissue, the cavity space cannot be substituted by suction alone. Though in a few cases the cavity secretions will remain "negative" as a result of suction, thoracoplasty is nevertheless required to close the space. In some cases it will be possible to do the major operation, with the catheter still *in situ*. This method, where practicable, would appear to offer the best chances of success. The principal objection to the use of suction followed later by thoracoplasty is a possible risk of wound infection during the major intervention, should the operative field involve the old catheter track. Histological examination, however, in a small series of cases has not shown tuberculous involvement of this track, and the usual secondary infection during suction rapidly clears up. Nevertheless, Maxwell and Konstam[10] and others advise the introduction of the catheter through the second intercostal space anteriorly, even in cavities situated above the second rib. This allows the first and second ribs to be removed completely and an efficient Samb type of apicolysis to be carried out as far as the level of the second rib in front without any risk of opening the catheter track.

3. As a palliative, if thoracoplasty is contraindicated, on account of: (*a*) Bilateral disease. The improvement of the general condition, the disappearance of tubercle bacilli from the cavity as well as its diminution in size and the clearing of other lesions resulting from the use of suction, will obviously be helpful to the patient should the response

be favourable. Such improvement may ultimately permit a thoracoplasty on one or even on both sides. (*b*) Position of cavity. A cavity in the apex of the lower lobe cannot effectively be controlled by thoracoplasty, even though complete. Further, such a cavity often fails to respond to phrenic nerve paralysis. Suction drainage alone, in my very limited experience of such cases, is unlikely to bring about permanent closure. Substitution of the cavity space appears especially difficult in this region. The combination of phrenic nerve paralysis, possibly supplemented by pneumoperitoneum, and suction drainage will in some cases produce improvement. (*c*) Age of patient. Most patients over fifty years of age are unsuitable for thoracoplasty. In patients under eighteen a trial of suction is preferable to thoracoplasty in the case of chronic cavities, which have failed to respond to pneumothorax or phrenic paralysis.

Association with other Treatment.

Most commonly ipsilateral phrenic paralysis is used both to help substitution of the cavity space and to allow vertical relaxation of the lung. This will help to eliminate the inspiratory tug on the draining bronchus and so permit of its occlusion. Occlusion will result in closure of the cavity. Success is most probable in those cases in which the cavity is not fixed to the chest wall by pleural adhesion, and in which there is sufficient healthy lung tissue to allow of efficient relaxation. At the Austin Hospital we found a few patients whose cavities closed only after ipsilateral diaphragmatic paralysis had been carried out following weeks or months of drainage. A few other patients, who had previously had phrenic paralysis, achieved cavity closure only after the institution of drainage. Suction drainage may be combined with any other special method for the contralateral lung.

In the Austin Hospital series of thirty patients, fourteen had ipsilateral phrenic paralysis, of whom five had pneumoperitoneum. Five had induction of contralateral pneumothorax.

Contraindications.

The contraindications are absolute and relative.

Absolute Contraindications.—The absolute contra-indications are: (*a*) a free pleural or extra-pleural space, (*b*) acute cavity formation, (*c*) extensive exudative disease in the lung. Occasionally, however, one is justified in draining a chronic cavity in the presence of exudative disease of slight or moderate extent, even of the caseous non-resolving type, provided that this is not in close relation to the cavity.

Relative Contraindications.—Hæmoptysis is a relative contraindication. As a rule any attempt at drainage should be postponed until the cessation of bleeding.

Technique.

If the lung is not already adherent in the region where the catheter is to be introduced, artificial adhesions must be induced. Brock[14] has shown that this is most effectively done by the intrapleural injection of ten minims of a 10% solution of silver nitrate.

Preliminary X-ray examination will include both postero-anterior and lateral films. Tomographs are often useful. I used them as a routine in Switzerland. Cavity pressure readings should also be taken and possibly cavernography carried out in some cases. The operation is best performed on the X-ray screening table. The patient should be recumbent with the head low to minimize the risk of cerebral air embolism. The cavity is usually approached from the front with the patient supine. I have, however, established drainage in several cases by the posterior approach with the patient prone. The risk of embolism and hæmorrhage obviously diminishes the smaller the amount of lung tissue traversed by the needle and trocar. Nevertheless most prefer the anterior route which is more comfortable for the patient. For the actual introduction of the trocar I have used the central ray technique of Monaldi.

This method is not applicable, of course, where the cavity is approached obliquely, as advised by Maxwell and Konstam[16] before thoracoplasty.

Firm fixation of the catheter is very important. Gentle suction is begun about twenty-four hours later. I have used either a steam escape or electric pump to obtain the negative pressure. Suction is carried on as a rule for twelve or fourteen hours a day. A special regulating apparatus is employed to control the pressures in each case. It is rarely necessary to exceed −15 centimetres of water. The treatment is carried on until repeated cultural examinations show that the cavity secretions are "negative", and in the case of single cavities the sputum also, and until no further reduction in the size of the cavity is perceptible on the X-ray film. Tomographs are of special value towards the end of treatment. The wound is dressed at least once daily and the catheter changed every four or six weeks.

Termination of Treatment.

When the maximum benefit has been obtained, lipiodol can be injected into the catheter. This will demonstrate the state of the bronchial communications as well as the outline of the cavity. "Cessation of manometric oscillations and inability to aspirate air from the catheter over prolonged periods are not certain indications of bronchial closure."[10] After the catheter has been withdrawn and the catheter track is healed, ascending bronchography will demonstrate the state of patency of the draining bronchi.

When the maximum benefit has been obtained, the catheter is withdrawn. Monaldi advises that this should be done slowly over a few weeks, presumably so that there is a chance of easy reinsertion should the cavity reappear. This slow withdrawal does not, however, seem indicated to me, if a good initial trial of suction fails to produce permanent closure of the cavity. Such permanent closure appears to depend on permanent obliteration of the bronchial communications of the cavity. It is to be hoped that some method will be introduced by which it will be possible to produce complete stenosis artificially.

Some English authors[18] reported a very small series of cases in which occlusion of the residual cavity space and draining bronchi was brought about by means of a plasma clot. I have not had any good results in the few cases tried.

One case is reported from the Swiss literature,[10] in which the draining bronchus was successfully occluded by the application of a silver nitrate stick to its outlet in the cavity. This was done blindly through a metal cannula introduced through the catheter track.

The introduction of an "operating" cavernoscope, similar to the operating thoracopscope, might make possible the development of some successful method of occluding the bronchial outlets under direct vision.

Crush of the phrenic nerve, followed in some cases by pneumoperitoneum, may be done before the withdrawal of the catheter.

Complications.

Embolism and hæmorrhage are the complications most to be feared. Monaldi reported one fatal case of cerebral air embolism. I have had one instance of mild cerebral embolism and one severe hæmorrhage on introducing the trocar. To prevent those complications Vineberg and Kunstler have adopted a technique involving the preliminary coagulation by diathermy of the lung tissue to be punctured by the trocar. Empyema should not occur if care is taken to see that the lung is firmly adherent to the chest wall in the region where the catheter is to be introduced. Since suction brings about a hyperæmia in the lung near the cavity, an exacerbation of pulmonary disease may occur if the patient's resistance is not good and if there are lesions with an exudative tendency in the region of the cavity. Secondary infection of the catheter track occurs frequently, but is usually mild and clears up rapidly when the catheter is withdrawn. Very occasionally infection in the chest wall has been reported. Almost invariably the catheter track heals without leaving a fistula.

General Management of the Patient.

To ensure the maximum relaxation of the affected lung, the patient should be kept at rest during the treatment

and for at least one month thereafter, even if he appears otherwise fit for exercise. Bathroom privileges without bath may be permitted unless otherwise contraindicated.

Results.

In the first series of 198 cases, in patients treated at the Forlanini Institute, Morelli[17] reported 64 which were failures or in which the treatment was abandoned and 134 in which the patient's condition was improved. Of the 134 patients who improved, 41 had completed their treatment for periods varying from one to fourteen months and the cavities remained closed and the disease arrested. In 1942, Monaldi[18] published in the German Press a review of his experience in his first 700 cases, but he does not give any details regarding the results.

I began suction drainage at the Austin Hospital in January, 1942. Since then we have used suction drainage for lung cavities in thirty patients. Not one of them presented ideal indications. For most no other special treatment was possible. In the very great majority, the cavities were of the open atmospheric pressure type with two or more draining bronchi.

Four patients had bilateral drainage simultaneously, and one had three cavities, two in one lung and one in the other, drained at the same time.

Nine of the patients are dead, two from the effects of bleeding as a direct result of the operation. In one case the trocar caused a very severe hæmorrhage which gave rise to a bilateral bronchopneumonia. The patient died some months later. In the other case, the catheter, as a result of friction, caused the rupture of an aneurysm of Rasmussen. The patient died three days after the beginning of treatment. Another patient achieved arrest of the disease. This satisfactory result persisted for eleven months, when the patient died suddenly from coronary thrombosis.

Another patient with bilateral cavitation and drainage of a large cavity in the right lung with ipsilateral phrenic paralysis, developed cyanosis and breathlessness after nine months' drainage. He died about a week later of failure of the right side of the heart. Post-mortem examination showed that the cavity had greatly shrunken in size and its walls were clean, a striking constrast to the untreated cavity in the other lung. This detergent effect of suction was noted in all cases in which post-mortem examinations were made. Two other patients, who are still alive, became worse while under treatment, as a result of extension of disease. The condition of three remained unchanged. Ten improved temporarily, but the cavities reexpanded and positive sputum returned within a few weeks or months after the withdrawal of the catheter. Four other patients, one with bilateral drainage, are much improved, at least temporarily. They have "negative" sputum and cavity secretions, but have not yet completed treatment. Two others have been well for periods of two and a half and two years respectively.

Two of my patients who had this treatment in Switzerland in 1939-1940 responded very favourably. One has kept well and is in the Fleet Air Arm. Without suction drainage he would have been submitted to thoracoplasty and would have been obliged to give up his career in the Air Force. The other, a girl, now seventeen years old, remained well for four years, but recently has, I hear, shown signs of fresh activity. Both had solitary cavities which would not close after long rest, in one case, supplemented by phrenic nerve paralysis.

Conclusions.

Monaldi's method has a definite though very limited place in the treatment of pulmonary tuberculosis. Its principal advantages are:

1. In tension and in some large cavities, its use will make more certain the success of thoracoplasty and diminish the risk of post-operative spread.

2. Very occasionally, the treated cavity will close and remain healed.

3. If means can be found to produce permanent occlusion of the draining bronchi, suction drainage will have a wider field of successful application and subsequent thoracoplasty will be avoided in many cases.

4. Its use has enabled us to obtain a clearer understanding of the pathogenesis and healing of cavities.

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Reports of Cases.

"PROMIN" IN TUBERCULOSIS: A SHORT PRELIMINARY REVIEW ACCOMPANIED BY SHORT CLINICAL NOTES OF THE USE OF "PROMIN JELLY" (5%) IN ELEVEN CASES.

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THROUGH the generosity of the manufacturers and the courtesy and kindly interest of their senior executive in Australia, Waterfall Sanatorium has been for some months the fortunate possessor of "Promin Jelly"[1] (5%) in sufficient

[1] "Promin" is scientifically called diamino-diphenyl-sulphone (dextro sodium sulphonate), and "Promin Jelly" is a 5% suspension in tragacanth jelly.

quantity to be able to undertake the treatment of several patients suffering from pulmonary tuberculosis and its added complications. Eleven of these patients, whose progress or otherwise under treatment has been sufficiently definitive to be of interest, are the subject of this present review. At the time of writing this paper, six months have not elapsed since the drug was first used in the first case on September 25, 1944, so of necessity the period of time in question is short.

These present patients are not the first patients here who have enjoyed "Promin" therapy. As far back as 1943 this institution was fortunate enough to come into possession of a small quantity of "Promin" in solution in ampoules for intravenous use. A young man, suffering from bilateral progressive exudative disease with cavitation, was treated continuously for six weeks, and the drug was pushed to tolerance limits as judged from clinical, hæmatological and urinary checks. No benefit resulted. The small supply left was used for intrapleural injection in specific empyema developing in five cases of artificial pneumothorax, in which other therapy had failed to sterilize the pleural fluid or lead to its absorption. In three cases of many months' standing, in which the clinical state was good, there was some evidence to justify an optimistic opinion, since in all three the fluid was absorbed eventually. In the other two cases, in which the patients were clinically very ill, no apparent benefit was observed. However, the amount of drug available for these cases was too small for any mature judgement to be formed.

The present series of cases, however—eleven have been chosen—seems to offer specific evidence, as far as it goes, that "Promin Jelly" (incidentally, this is the only form in which we could secure the drug) applied topically does lead to eradication of the infection and to promotion of healing in varied forms of extrapulmonary tuberculosis. However, there is no evidence that its use within the lungs in three cases, or within the pleural cavity in two cases of this series, has made any permanent difference one way or the other. But Case I, in which tuberculous ulceration was progressively destroying all the tissues surrounding a permanent tracheotomy stoma, and Cases III and IV, which have both terminated fatally, but in which the "Promin" treated lesion had healed in one case and almost healed in the other while the general condition was deteriorating, seem to offer an eloquent testimony as to the efficacy of the drug. However, the short notes surrounding each case will suffice to present a clear picture in outline.

As has already been pointed out, the therapy has not yet lasted for six months in any one of the cases.

Case I.

W.J.McG., aged fifty-four years, has bilateral extensive disease with cavitation at both apices, of eight years' duration. The sputum contains tubercle bacilli. Laryngeal tuberculosis is now healed, and the resultant cricoarytenoid joint fixation necessitated a tracheotomy about four years ago; the patient has been wearing a tracheotomy tube since. Nine months before "Promin Jelly" was used, the wound edges began to ulcerate and the ulceration extended finally to cover an area measuring two inches by three and a half inches of skin and subjacent tissues, including the trachea on the left side, where chondritis developed. Despite varied treatment the ulcerative process continued to progress. On September 25, 1944, "Promin Jelly" dressings were instituted, being applied twice a day. Within two weeks there was evidence of arrest of spread; now after four months the skin surfaces are epithelializing right up to the wound edge, and the chondritis has subsided subjectively and objectively; but meanwhile the general condition of the patient is deteriorating.

Case II.

E.H.H., aged sixteen years, has bilateral upper lobe disease with cavitation and sputum containing tubercle bacilli. A left phrenic crushing operation was performed on May 8, 1944, and two days later the right testicle became swollen and painful. Pyrexia developed, and the condition subsided into one of swelling and tenderness of the epididymis. The swelling was the size of a walnut, and it gradually softened; three millilitres of creamy pus were aspirated from it, the pus being rich in *Mycobacterium tuberculosis*. Two sinuses formed from the abscess cavity to the exterior, and the condition resisted treatment including heliotherapy. On September 26, 1944, daily injections of "Promin Jelly" were commenced and continued till January 20, 1945; by that time the abscess cavity and sinuses had healed, despite the fact that meanwhile the prostate has become swollen and tender and the urine now contains *Mycobacterium tuberculosis*.

Case III.

E.W.A., aged forty-three years, suffered from advanced disease with extensive cavitation of the upper lobes of both lungs and extensive ulcerative laryngeal involvement, the cords and cartilages included. There was also an indurated, multi-fissured area of ulceration on the right margin of the tongue, extending over an area measuring one and a half inches by one inch. Silver nitrate (20%) was applied each day to the tongue ulcer without benefit for a period of six weeks. Then daily applications of "Promin Jelly" were begun. At the end of twelve weeks there was considerable improvement and complete healing was anticipated. The general condition of the patient had deteriorated throughout this period, and he was transferred to a hospice in February, 1945, taking with him a tube of "Promin Jelly", but he died a week after transfer.

Case IV.

I.M.B., aged twenty-eight years, had a history of pulmonary tuberculosis of eleven years' duration, and on her admission to hospital had extensive involvement of both lobes of the left lung with cavitation and minor involvement of the upper lobe of the right lung. The left kidney was tuberculous and was removed in 1942; a short ureteric stump was left. Urine from the right kidney contained *Mycobacterium tuberculosis* on the patient's admission to the sanatorium.

Cystoscopic examination revealed that the trigone was inflamed and tubercles were present. Pus was coming from the left ureteric orifice. A tuberculous ulcer was found, extending from this orifice upwards to the vertex of the bladder. The capacity of the bladder was 120 millilitres. The right ureteric orifice was normal. Indigo-carmine injected intravenously appeared in five minutes.

Six weeks after the patient's admission to hospital, the daily administration of "Promin Jelly" injections was commenced on November 8 and continued till December 24, 1944 (except for four days, during a bout of severe hæmoptyses), when, because of urethral irritation—due possibly to the repeated catheterization—they were suspended. On November 21 a cystoscopic examination revealed evidence of healing, and the bladder capacity was 150 millilitres. On January 6, 1945, cystoscopic examination revealed the following findings. The ulcer around the left ureteric orifice had disappeared; the trigone was still red, but no tubercles were seen; at the vertex there was an isolated ulcer with clean edges and tubercles within the ulcerated area. The bladder capacity was 170 millilitres.

The general condition of the patient had deteriorated, and she had on occasion come close to exitus. She died on February 25, 1945, and at autopsy no ulcer or tubercles were found on macroscopic examination of the urinary bladder. The mucosa over the site of the ulcer was thin and abnormal, and that over the trigone was thick and dark. According to the pathologist's report, microscopic examination of sections of the bladder wall from the trigone and the vertex ulcer site revealed the presence of tuberculosis of the mucosa.

Case V.

R.P.D., aged twenty-two years, has a large cavity in the upper part of the lower lobe of the right lung, with thick fibrous walls, that has resisted extensive treatment by artificial pneumothorax, phrenic paralysis and negative-pressure breathing exercises. The sputum contains *Mycobacterium tuberculosis*. From November 8, 1944, through a nasal catheter, "Promin Jelly" instillations into the bronchus were made, as follows. The aperture of the catheter was adjusted under the fluoroscopic screen to the cavity exit on each occasion, and the patient was kept in position for fifteen minutes after the instillation. On November 8, fifteen millilitres of "Promin Jelly" were instilled, on November 15, twenty millilitres were instilled, and on November 29, twenty millilitres were instilled. On each occasion, on the day after instillation the patient experienced drowsiness that was thought possibly to be due to the local anæsthetic agent—"Decicain" (1%) was used. Otherwise he felt well and manifested no radiological or physical signs till December 10, approximately twelve days after the last instillation, when limb pains, mild pyrexia with a rise of temperature to 99·6° F. and profound anorexia supervened and persisted for forty-eight hours. As these signs passed off, a feeling of "bloated abdomen" supervened and lasted about thirty-six hours; no cause was found. Then the patient began to experience a feeling of well-being above the average, but the cavity remains as before and the sputum still contains *Mycobacterium tuberculosis*.

Case VI.

M.H., aged fifty-two years, has extensive disease of the upper lobe of the right lung, with multiple cavitation and considerable fibrosis. The sputum contains tubercle bacilli. On December 8, 1944, the same technique being used as in Case V, twenty millilitres of "Promin Jelly" were instilled; the patient experienced no reaction whatever. On December 15 twenty millilitres of "Promin Jelly" were instilled, and no reaction was experienced for forty-eight hours. Then the words of the patient—"I feel as I did when the disease was coming on"—were the signal for quite a disturbing episode. The temperature rose to 101·2° F. and did not become normal for four days; profound anorexia that persisted for six days and an increased quantity of sputum also were in evidence. Some fifty-six hours after the onset of symptoms, the upper lobe of the right lung exhibited showers of the coarsest râles I have heard; within a few hours similar râles were in evidence over the lower and middle lobes of the right lung, with two areas of sounds resembling a particularly loud pleural friction rub, and a few hours later still, some minor râles were heard at the base of the left lung. A few hours later these last had cleared, as also had the sounds in the lower regions of the right lung, except for the friction rub effects, which persisted for some hours longer; meanwhile the upper lobe of the right lung retreated to making a few indefinite but widely distributed coarse râles. Investigation of the blood picture revealed some minor degree of anisocytosis and poikilocytosis, but nothing else of note, and albumin appeared fleetingly in the urine.

Complete recovery eventuated, but the sputum still contains *Mycobacterium tuberculosis*. Radiologically, a dense opaque area appeared in the outer two-thirds of the lower lobe of the right lung during the fever and gradually disappeared by absorption from the medial aspect, till there persisted only a small opaque area at the periphery occupying the site of a hydatid cyst evisceration made some thirty-six years previously. This has now vanished.

Case VII.

G.B., aged forty-two years, has a large post-thoracoplasty sinus with profuse offensive purulent discharge that had shown no definite improvement over many months. *Mycobacterium tuberculosis* was found in the discharge. Daily injections of "Promin Jelly" were begun on November 14, 1944. By December 24 the discharge had become serous and non-offensive. On January 25, 1945, the injections were suspended, as no further improvement was manifest. On February 12 they were resumed, as there was evidence of decrease in the amount of the discharge, which maintains its serous nature. On March 7 there was only a minor amount of thin, non-offensive discharge.

Case VIII.

M.K.K., aged eighteen years, had a large ballooning cavity in the upper lobe of the right lung (radiological diameter, three inches in all directions) and a perianal abscess half an inch long, a quarter of an inch wide and three-quarters of an inch deep. On December 14, 1944, daily instillations of "Promin Jelly" into the perianal abscess were commenced; on February 9, 1945, the abscess had ceased to discharge, and was a slit a quarter of an inch long and a quarter of an inch deep. On March 7 it was healed.

On December 15, 1944, one millilitre of "Promin Jelly" was injected transthoracically into the lung cavity; another ten millilitres were injected on December 27, and a further thirty millilitres on December 30, when the pressures suggested that further filling might be risky. On February 12, 1945, there was a fluid collection some six millimetres deep at the lower pole of the cavity, but no other change. No untoward symptoms have been experienced and no benefit has resulted.

Case IX.

L.V.N., aged twenty-four years, is a patient with a left artificial pneumothorax for whom thoracoscopy was performed and section of adhesions attempted but not pursued because of technical difficulties. The next day spontaneous pneumothorax developed, due supposedly to further tearing of an adhesion whose section had been attempted. After this a mixed infection pyopneumothorax developed, *Staphylococcus aureus* and *Mycobacterium tuberculosis* both being found in the pleural pus, and the patient became acutely ill, but recovered somewhat under intrapleural penicillin treatment. However, a broncho-pleural fistula developed, and has persisted, and for nine months he has failed to make headway and is now almost *in extremis*. Everything possible in the way of pleural medication has been attempted, and a further series of penicillin injections, this time parenterally, was instituted, with some evidence of benefit. Altogether he has had 1,000,000 units intrapleurally and 500,000 units parenterally.

On February 19, 1945, intrapleurally, after aspiration and saline lavage, three millilitres of "Promin Jelly" were injected, and the same procedure with the injection of six millilitres of "Promin Jelly" was repeated on February 26. The pus still contains *Mycobacterium tuberculosis*, and it now contains also a Gram-positive diplococcus.

The chief interest in reporting this case is that the patient has experienced no specific discomfort from the intrapleural injection of "Promin Jelly".

Case X.

N.H.D., aged twenty-three years, on admission to the sanatorium, had left pyopneumothorax following artificial pneumothorax treatment. The pus was rich in *Mycobacterium tuberculosis*, but contained no other organisms. On January 26, 1945, "Promin Jelly" (twenty millilitres) was injected intrapleurally after aspiration of pus. No reaction was experienced. On February 2 the procedure was repeated, and within a few hours the patient experienced a severe ache in the left shoulder region that subsided within twenty-four hours of the onset. On February 8 the procedure was repeated without reaction. On this occasion the pus aspirated seemed to be much thicker. No further injections have been made to date, and the patient's condition remains as before.

Case XI.

E.J.K., aged twenty years, has a small thoracoplasty sinus. The use of "Promin Jelly" as a daily dressing was begun on December 30, 1944. By February 9, 1945, the discharge had decreased by 75%. Since then no improvement has occurred. It is believed that the jelly is not reaching a recess that is too narrow for penetration.

Acknowledgements.

My colleagues on the resident staff of this institution, Dr. C. Y. Bland, Dr. G. C. Hughes, Dr. H. Wilson and Dr. H. Landecker, have all taken part in using the drug and keeping close observation on the patients. It has been our aim to offer a few definite and checked observations as early as seemed indicated. I have to thank the Director-General of Public Health in New South Wales for his courtesy in consenting to publication of these observations.

Reviews.

A BIBLIOGRAPHY OF OPHTHALMOLOGY.

A VOLUME destined to be of great value to medical libraries and to ophthalmologists who devote much study to the literature of their subject has been prepared by the Committee on Aviation Medicine of the Division of Medical Sciences of the National Health Council of the United States. It is "A Bibliography of Visual Literature, 1939-1944" and has been compiled by J. F. Fulton, Phebe M. Hoff and Henrietta T. Perkins.[1] In the preface we read that the compilation of the book followed on a request from the British Air Ministry for a classified bibliography covering all literature on vision that might have relevance in military operations, on land, at sea or in the air. This is the scope of the work. The compilers have concentrated on the biological aspects of the subject. They have been forced to exclude aerial photography, optical engineering and optometry, since these would have taken them too far afield, and they have also largely omitted general ophthalmology and ocular pathology. The several sections deal with anatomy and physiology, physiology and psychology, visual examination and testing (including methods and instruments), correction of ocular defects in military personnel, training for military specialities, ocular trauma (in military services), goggles and ocular protection, illumination and visibility. There are also an index to authors, an index to subjects and a key to abbreviations of the journals cited. The references number 3,347.

[1] "A Bibliography of Visual Literature, 1939-1944", compiled by John F. Fulton, Phebe M. Hoff and Henrietta T. Perkins; 1945. Washington: Committee on Aviation Medicine, Division of Medical Sciences, National Research Council. Springfield: Charles C. Thomas. 10½" × 7½", pp. 127. Price: $3.00.

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THE MODERN TREATMENT OF PULMONARY TUBERCULOSIS IN AUSTRALIA.

THE essential feature of the treatment of pulmonary tuberculosis is rest. Surgical measures were first applied in the treatment of the disease in order to reinforce the general rest imposed on the patient. The production of artificial pneumothorax was the first surgical procedure to be introduced, and from it all later developments have sprung. Artificial pneumothorax was first advocated in 1820 by James Carson, who made a series of experiments showing the effects of artificial pneumothorax on the circulation. In 1820 he wrote:[1]

> Whether the method proposed will be found practicable or, if practicable, to the desired extent beneficial, or whether, as will be supposed by far the most probable, it may amuse for the moment and then, like all its predecessors, sink into deserved neglect, are questions which must be left to the decision of time.

The procedure was not destined to "sink into deserved neglect"—any neglect was undeserved. L. S. T. Burrell, in a "special report" published by the Medical Research Council of Great Britain in 1922, states that Cayley treated at the Middlesex Hospital in 1885 by means of artificial pneumothorax a patient who was suffering from hæmoptysis, and that it was about this time that Forlanini began to use the treatment in Italy. As a matter of fact artificial pneumothorax therapy was used much more widely on the continent of Europe than it was in Great Britain. There was every justification for Burrell's statement in 1922 that too little was known about artificial pneumothorax in Great Britain and that many physicians regarded it as a method of treatment which had been found wanting instead of one which had slowly but surely spread itself all over the world. Incidentally it may be observed that Burrell gave an effective answer to Carson's statement of nearly one hundred years before, for he declared that he knew of no one who had made a serious attempt to use artificial pneumothorax and had abandoned it. Burrell's statement that pneumothorax therapy has spread all over the world is quite true. At the same time Australian clinicians should ask themselves whether his declaration of 1922 about deficient knowledge of artificial pneumothorax in Britain does not apply to Australia in the year 1945. The question is all the more important in view of the remarkable way in which collapse therapy has progressed during the past twenty-five years. It is one thing to have knowledge of a method of treatment and even to be familiar with the details of its application; it is another to be so appreciative of its value as to use it whenever it is likely to produce a useful result. The mental attitude of members of the medical profession towards the whole question of tuberculosis as well as their knowledge of the details of treatment will determine the restricted or the widespread use of collapse therapy. Thus, although in actual practice special methods of treatment will be applied almost exclusively by those who have devoted special study to tuberculosis therapy and regard it as a special part of their activities, no practitioner should fail to make himself familiar with the tuberculosis problem as a whole, with the preventive aspect of the subject and with the scope and value of the general and special methods of treatment in the present state of its evolution. It is in order to focus attention on this subject that the three papers presented by Dr. Hilary Roche to medical gatherings in South Australia and Victoria are published consecutively in the present issue.

Everyone is agreed that the treatment of the patient with pulmonary tuberculosis includes not only what is done for the patient himself, but what is done for the protection of his dependants and for their support while he is undergoing treatment. In the present discussion attention will be directed only to treatment of the patient. Emphasis should be laid on Dr. Roche's contention that treatment has what may be called a three pronged character. First comes sanatorium treatment, one of the main advantages of which is in many instances the education of the patient into the nature of his illness and the inculcation of certain habits that lead to a suitable way of living. To the sanatorium treatment which has the effect of increasing the patient's resistance. Dr. Roche adds collapse therapy "to aid healing". Although collapse therapy is the term generally used, we do well to remember Alexander's reference to it as an unfortunate term. As Dr. Roche reminds us, Alexander referred to pulmonary relaxation. Any who doubt the wisdom of Alexander's description will be convinced if they examine skiagrams taken before and after the division of certain types of adhesion by pneumolysis. The third prong in the treatment is the provision for every patient of opportunities for self-improvement and a desirable occupation after discharge from hospital. We do not propose to describe the methods adopted to produce collapse of the lung; this has been done in an admirable way by Dr. Roche. The summary given by him in his second paper of the factors in the evolution of collapse therapy in the last twenty-five years is most useful and could well be used as a basis for discussion by interested groups of practitioners. In regard to the question whether collapse therapy is widely enough used in Australia at the present time, the first inquiry must deal with the number of beds available for the treatment of patients with pulmonary tuberculosis. Everywhere the plea is for more beds. In Victoria the Commission of Public Health in its twenty-second report, covering the year 1943-1944, states that there are in the State about 700 beds. The number of beds needed is

[1] Quoted by W. P. Morgan: "Pneumothorax in the Treatment of Tuberculosis", *The Quarterly Journal of Medicine*, Volume XI, 1917-1918, page 1.

three per death. The commission requires for the future at least 1,400 additional beds. This means that the number of beds to the number of deaths is 1 to 1. In South Australia the ratio is approximately 1·7 to 1. To show what can be done, it may be pointed out that in the Province of Ontario, Canada, the ratio of beds to annual deaths is 3·7 to 1. In Victoria difficulties in regard to staff have been considerable. On several occasions during the year 1943-1944 two of the sanatoria had to cease receiving patients for some months. In addition whole wards have had to be kept vacant which could have been utilized had staff been available. The average waiting period for admission to a sanatorium has increased in Victoria from three weeks to five months. On the figures for available beds alone it is clear that patients with pulmonary tuberculosis are not receiving adequate treatment, and this must also mean that surgical measures are not being used as extensively as they should be used. Whether these surgical measures could with advantage be used oftener in the treatment of those who do find beds in sanatoria is difficult to determine. The data available are not so helpful as they might be and opinions may differ in regard to indications. The figures from Frome Ward, Adelaide, through which most of the patients come into the civilian tuberculosis service, show that during the years 1942, 1943 and 1944, the total number of admissions was 969. During this period artificial pneumothorax inductions numbered 261; this number included about 20% of unsuccessful attempts. The numbers for other procedures were as follows: phrenic nerve crush or avulsion, 3; division of adhesions, 17; thoracoplasty, 18; drainage of empyema, 17; general surgery (this includes bronchoscopy and operations on the ear, nose and throat), 32. One patient may have been submitted to several of the procedures; in other words the figures are figures relating to operations and not to patients treated. The low number of artificial pneumothorax inductions has been described as due more to unsuitability of material than to disinclination to perform the operation. In the Victorian report it is stated that 111 patients at sanatoria "are receiving" artificial pneumothorax treatment. There is no indication of how many beds were occupied at the period to which this statement applies, nor of whether any of the patients occupying them had been treated in this way and were no longer receiving the treatment. Between 1930 and 1943 the operation of thoracoplasty was performed on 111 patients; but no total for this period is given. In any case, if the statistics were complete in these matters in every State, it would still be necessary to know what criteria were adopted in each instance. Information of this kind is not given in the reports of hospitals or government departments. To quote the opinions of observers that more use should be made of surgical treatment in pulmonary tuberculosis is not helpful unless full details are given. What can be done, however, is to emphasize the value and indispensability of surgical treatment and to urge a dispassionate stocktaking of the position from every point of view—general facilities, equipment, knowledge, availability of operative and technical skill, and receptivity of mind with readiness to investigate the opinions of those with experience and judgement. In other words—the kind of stocktaking that any scientifically minded practitioner of medicine should be willing to undertake. This applies to those who may be called enthusiasts as well as to those who cannot be so classed. It is not outside the bounds of possibility that some of the surgical procedures that are adopted as part of the treatment of patients with pulmonary tuberculosis may be applied from time to time unwisely and not of necessity.

From Dr. Roche's three articles and from the present discussion it is clear that the subject of tuberculosis is of enormous extent. It demands intense study and there is room in this country for practitioners who will give their whole attention to its prevention and treatment. Further in the teaching of students special emphasis should be laid, for example, on the scope of such a procedure as the induction of artificial pneumothorax. Unless the general practitioner knows what can be done he will condemn unfortunate sufferers to the fate of inadequate treatment. Too many men still hold the view that bilateral pneumothorax is a condition that should never be allowed to occur.

Two final points must be mentioned. The first is that those who deal extensively with tuberculosis patients will profit enormously if they take counsel one with another over individual patients and on general questions. It was not without reason that the British Joint Tuberculosis Council insisted in a report mentioned in the *British Medical Journal* of October 14, 1944, on the "unwisdom of allowing tuberculosis clinicians to work in isolation". Specially should this be remembered when the difficult question of the repatriation of tuberculous soldiers has to be faced. The other remaining point has to do with the third prong in treatment mentioned by Dr. Roche—the provision of opportunity for self-improvement and for a desirable occupation. Occupational therapy has received attention in Victoria and elsewhere, but there is something to be done beyond this for the convalescent. The day will come when we shall have our settlements for tuberculous persons who are able to work. In this regard we would again draw attention to the working centres that have been established by Dr. Linley Henzell in Western Australia at the Wooroloo Sanatorium. (See THE MEDICAL JOURNAL OF AUSTRALIA, December 2, 1944, page 597.) This is a work deserving of the highest commendation and also of emulation.

Current Comment.

THE THERAPEUTIC USE OF RADIOACTIVE PHOSPHORUS.

THE discovery of artificial radioactivity by Curie and Joliot in 1934 opened up a new field for the study of the mechanisms by which the various elements and compounds essential for life are assimilated, distributed throughout the tissues of the body, converted into other compounds and eliminated. J. G. Hamilton has pointed out that prior to this discovery these problems could be approached only by direct chemical methods.[1] The development of the cyclotron by E. O. Lawrence and his associates, coupled with Curie and Joliot's work, has been followed by the preparation and identification of radioactive isotopes of all the stable elements. Hamilton states that "these momentous developments have given the biologist probably the most useful tool for research since the discovery of the microscope, because almost all of the elements and compounds present in biological systems can be 'tagged' with the aid of artificial radio-elements and their course in living structures directly studied". Hamilton goes on to show that since Chiewitz and Hevesy first used artificial radioactivity in the study of phosphorus metabolism in

[1] *Radiology*, Volume XXXIX, 1942, page 541.

rats, radioactive isotopes of twenty-one elements have been used in various fields of investigation and practically all the biological sciences have been included.

The production of radiophosphorus is an interesting procedure. According to a description given by B. V. A. Low-Beer, J. H. Lawrence and R. S. Stone,[1] a thin layer of red non-poisonous metallic phosphorus is packed on a copper plate, called the target, and placed in the vacuum chamber of the cyclotron, where it is bombarded by fast-moving deutrons (the nuclei of heavy hydrogen). The deutrons consist of a proton and a neutron. The deutrons in gaseous form strike some of the nuclei of the phosphorus atoms on the target. Because both are positively charged, the proton is deflected from the phosphorus nucleus. The neutron which has no charge enters the nuclear field and not only causes a change in the atomic weight of the phosphorus from 31 to 32, but also disrupts its stable nuclear structure and thus transforms it into a radioactive atom. The bombardment in the cyclotron is continued for many hours, but it is not possible to make all or even an appreciable percentage of the phosphorus atoms radioactive. A time comes when as many of the radioactive atoms are disintegrating each minute as are being formed. Low-Beer, Lawrence and Stone point out that when the bombardment is stopped the phosphorus must be converted into sodium acid phosphorus by a procedure which they describe. For intravenous use sterilization of the product is necessary; for oral use it is not.

Artificial radio-elements have a dual significance in medical science. They may be used first of all in the field of pure research and secondly in that of practical therapeutics. The use of these substances in therapeutics is dependent on successful research in metabolism. To the latter kind of research the term "tracer" research has been applied. Experimental or "tracer" research with radiophosphorus on normal animals has shown that this phosphorus is metabolized in the form of inorganic phosphate, phosphonucleotides, hexose phosphates and similar compounds and is incorporated in living cells. It has also been shown that bone is the site of greatest concentration of newly acquired phosphorus and that in animals with leuchæmia, lymphoma, lymphosarcoma and other tumours a higher percentage of phosphorus is taken up in the pathological tissue than in any of the normal tissues, with the exception of bone. This summary of the research is set out by Low-Beer, Lawrence and Stone, who point out that these findings indicate that rapidity of growth influences the rate of uptake of phosphorus. It has also been found that therapeutic doses of radiophosphorus reduce the number of leucocytes in the peripheral blood of leuchæmic animals to a greater extent than in that of normal animals or those with localized tumours. Low-Beer and his two fellow workers recorded some clinical experiences. They concluded that it was too soon to compare the results of radiophosphorus treatment with other methods in such conditions as chronic myelogenous leuchæmia, chronic lymphatic leuchæmia and lymphosarcoma. It should also be mentioned that in 1942 L. A. Erf published some clinical studies with radiophosphorus,[2] in which he recorded the amounts of radiophosphorus retained by various tissues of 32 patients dead of leuchæmia. He found that radiophosphorus was concentrated in greatest quantities in those tissues which were most frequently infiltrated with leuchæmic cells.

The latest work on this subject comes from Shields Warren, of Boston, who reports the results of treatment with radioactive phosphorus in 81 cases of leuchæmia, myeloma, Hodgkin's disease and *polycythæmia vera*.[3] In his introductory remarks he points out that radioactive phosphorus has a half-life of 14·3 days and that, like all radioactive substances, it has a steady rate of decay. The β rays that are given off have relatively low penetrating power, but certain cells, and among them leuchæmic cells, preferentially absorb the material. The end product of the reaction, which is sulphur, is not radioactive and is harmless. The cases chosen by Warren for treatment were those belonging to what he calls a relatively unfavourable group—those which after initial favourable response to X rays had become resistant, and those cases of leuchæmia in which X radiation is known to be unsuccessful—for example, cases of acute leuchæmia in childhood. This selection would appear to be wise. As a rule the phosphorus was given intravenously, dissolved in sodium chloride solution and glucose. Oral administration was used only in a few cases, and then as a check against the intravenous method. The best results were obtained in previously untreated cases of chronic and subacute myelogenous leuchæmia; seven of eleven patients manifested improvement. Also of eleven patients suffering from lymphatic leuchæmia, who had previously been treated with X rays, seven manifested improvement. The detailed histories of some typical cases are given—in some instances no results were achieved and in others life was prolonged for considerable periods. The conclusion is that the treatment is palliative rather than curative. Apparently a great deal depends on the extent of the involvement of the bone marrow by the leuchæmic process at the time when therapy is undertaken. If extensive leuchæmic infiltration is present with very little normal hæmatopoiesis, nothing will be gained by wiping out the leuchæmic cells—an aplastic anæmia will be substituted for the leuchæmia. For this reason a sternal bone marrow biopsy is held to be desirable before treatment by radioactive phosphorus is undertaken. Warren deals in his discussion with many interesting points which cannot be considered in the space available. Reference must be made, however, to the fact that his studies of distribution of radioactive phosphorus in the tissues of leuchæmic patients confirm the results reported by Erf that have been mentioned. In his detailed case histories Warren describes a case of *polycythæmia vera*. This condition is described in the same journal as that containing Warren's article by B. E. Hall, C. H. Watkins, M. M. Hargraves and H. Z. Giffin, of the Mayo Clinic, who have used radioactive phosphorus therapy in twelve cases. They find that the method of treatment is in no way curative, but that by its means the disease can be more readily controlled than with any other available procedure. At the same time leucopenia, thrombocytopenia and anæmia may be produced and careful observation is needed to prevent irreversible damage to the bone marrow.

This work on radiophosphorus is still in its early stages and no doubt with further developments in technique more profound and more lasting results will be obtained. But the real significance of the work lies in the kind of experimental research which it typifies. Work has been done with one or two other elements. Low-Beer, Lawrence and Stone refer to investigations that have been undertaken with strontium, iodine and chromic phosphate. Radioactive strontium is selectively taken up by the bones and its value in the treatment of neoplastic disease of bone is, they state, being investigated. Radioactive iodine has proved effective in the treatment of hyperthyreoidism. The thyreoids of patients with hyperthyreoidism show an increased and selective accumulation of radioiodine. Further, Hamilton and Soley are quoted by Low-Beer, Lawrence and Stone as having shown that the accumulation is highest in previously untreated patients and that the administration of Lugol's solution decreases the storage of radioiodine. Further study may be expected to clarify this aspect of the subject and to reveal the scope of radioiodine. Unfortunately, radioactive iodine is not taken up regularly by cancer cells originating in the thyreoid. Everything that has been mentioned shows that scarcely the fringe of this enormous subject has been touched. Hamilton has stated that the radioactive isotopes of only twenty-one elements have been employed in biological research. Of this number only a few have been studied with selective localization as the primary aim. He writes that, since each of the 92 known elements has one or more radioactive isotopes and many of these have half-lives that place them within the range of therapeutic applicability, it is evident that the potentialities in the field of selective irradiation far outweigh the little that has been accomplished so far. We are justified in expecting great things from this kind of therapy in future, and it may not be very far off.

[1] *Radiology*, Volume XXXIX, 1942, page 573.
[2] *The American Journal of the Medical Sciences*, Volume CCIII, 1942, page 529.
[3] *The American Journal of the Medical Sciences*, June, 1945.

Abstracts from Medical Literature.

MEDICINE.

Diabetic Coma.

H. F. ROOT (*The Journal of the American Medical Association*, March 10, 1945) discusses the use of insulin and the abuse of glucose in diabetic coma. He points out that deficiency of insulin is the cause of diabetic coma, and that insulin cures coma because it enables the body to use glucose present in the blood and fluids of the tissues. It restores glycogen depots and provides energy for the body by oxidation of carbohydrate instead of fat, and so stops excessive ketone formation. The author maintains that glucose is harmful in coma, and points out that the mortality rate at Joslin's diabetic clinic was as low as two in the last 123 cases. He states that these figures are far better than those of clinicians who use glucose. In diabetic coma acetone bodies in the blood are increased as a rule in proportion to the severity of the coma. In this series of cases unconsciousness did not occur until the acetone in the blood was higher than 100 milligrammes per 100 millilitres of blood. Diabetics in the less severe stages of coma, who were conscious or drowsy, showed blood acetone figures between 40 and 100, usually about 70 milligrammes *per centum*. The carbon dioxide content of venous blood was, however, the more valuable criterion in determining the severity of diabetic coma, and showing the depletion of the alkali reserve and the imminence of lethal irreversible changes in the central nervous system. Isotonic solution of sodium chloride given subcutaneously and intravenously up to 10% to 15% of body weight was an essential part of the treatment of coma. In coma the glycogen in the liver was much reduced and the fat content was increased. The sugar in the body is particularly abundant in the skin during coma, as much as 28 grammes of glucose being concentrated in the skin in coma, as against four grammes normally. Extracellular body fluids contain glucose in similar amount to the blood in coma. The author has shown that the administration of glucose does not increase the oxidation of carbohydrate during coma, and that there is ample glucose present in the body to make possible glycogen formation during the eight hours which may precede the resumption of the diabetic diet. Treatment should be prompt, preferably in hospital, where blood tests can be made. As a rule twenty to sixty units of insulin should be given as soon as the diagnosis is made and before the patient is sent to hospital. At hospital the dose of insulin will depend on the severity of the coma. Fifty to one hundred units should be given in a mild case to an adult. In severe cases with unconsciousness, 100 units should be given subcutaneously and 50 or more intravenously, and a second dose half an hour later. When the blood sugar level is determined, if it is more than 600 milligrammes, 200 to 300 units of insulin should be given in the first hour. Urine and blood tests should be made every two hours. After the first few hours, a Benedict's test may be used as a rough guide for insulin dosage. If the urine with Benedict's solution shows a red reaction, 24 units of insulin are given, if the reaction is orange, 20 units are given, with yellow 16 are given, with yellow-green 8 units, with green 0, and blue 0. The essential treatment lies mainly in the early large doses. In Joslin's clinic the amount of insulin required in the first twenty-four hours has paralleled the blood sugar content to some extent. With a blood sugar content over 1,300 milligrammes *per centum*, 1,224 units are given; with a blood sugar content of 200 to 400 milligrammes, 162 units are given in 24 hours; a 400 to 600 milligramme blood sugar level requires 250 units; a level of 600 to 1,000 milligrammes requires 387 units; and a level of 1,000 to 1,300 units requires on an average 815 units. The frequency with which urine and blood sugar tests are made can be diminished to three, four or six hour periods as recovery occurs. Normal saline solution should be given at once, 1,500 millilitres intravenously and the same amount subcutaneously. This may need to be repeated in a few hours. In anuria saline solution is given continuously by the intravenous route, one litre per hour, until blood pressure rises and urinary secretion begins. The average patient will need four to seven litres in the first twenty-four hours. Gastric lavage is advisable with warm water, preferably with a large Ewald tube. After six hours food should be given hourly—three or four ounces of warm broth, salted liquid, thin gruel, or tea with a little sugar. The same amount of orange juice or ginger ale suits some patients. Ten grammes of carbohydrate per hour and 30 to 50 grammes each of protein and fat in the first twenty-four to thirty-six hours should be the limit of feeding. Intravenous administration of glucose is not indicated; in fact it is contraindicated, unless the patient cannot be fed by mouth, and then from six to twelve hours after the initial large dose of insulin glucose solution may be given intravenously as a means of providing food.

Insulin: The Newer and the Older Forms.

L. BAUMAN (*The American Journal of Digestive Diseases*, January, 1945) discusses the use of (*a*) uncombined, (*b*) globin and (*c*) protamine insulin either separately or in combination. He uses plain insulin in gastric upsets, before and after operations, in diabetic coma, and as an adjuvant in severe cases when a large dose of protamine zinc or globulin zinc insulin is required. A dose of protamine zinc insulin large enough for a twenty-four hour control may induce hypoglycæmia after midnight, whereas a comparable dose of globin zinc insulin may unduly depress the blood sugar level between four and five o'clock p.m. In this latter case, the effect will be more readily detected. If one-fifth of the carbohydrate allotment is given at breakfast, two-fifths at luncheon and two-fifths at dinner, efficient control is usually obtainable with a single dose of globin zinc insulin. However, modifications must be made to suit the particular patient. The addition of a small dose of protamine zinc insulin with a corresponding decrease in globin zinc insulin, given separately before breakfast, may dovetail in a most gratifying manner and produce effective control when every other combination has failed. The inexperienced physician is apt to err in several respects: (*a*) in the idea that the condition of all diabetics is easy to regulate; (*b*) in not allowing ample time for the body to adjust itself to a diet and insulin dosage before a change is made; (*c*) in encouraging careless habits of control.

Hydrochloric Acid Therapy in Achlorhydria.

E. FRANKEL (*The American Journal of Digestive Diseases*, January, 1945) confirms the findings of previous investigators that the administration of dilute hydrochloric acid to achlorhydric patients in therapeutic doses fails to raise the acidity of the stomach during the digestive cycle. Clinically, spectacular therapeutic results are sometimes obtained with hydrochloric acid for the relief of vague but distressive digestive symptoms, allergic conditions, or in gastrogenous diarrhœa of achlorhydric patients. These effects derived from hydrochloric acid in the usual dosage cannot be caused by the presence in the stomach of any free acid at the time of digestion. Whether the effects are psychological or arise because some acid reaches the duodenum and stimulates it to secrete its vital hormones, remains a matter of conjecture.

Gastric Acidity in Duodenal Ulcer.

G. E. BROWN, JUNIOR, AND A. B. RIVERS (*The American Journal of Digestive Diseases*, February, 1945) try to explain the reason for the greater incidence of duodenal ulcer among men than among women, the ratio of which has been variously stated as being from 4 to 1 to 20 to 1. The levels of gastric activity as recorded for women have been found as a rule to be less than the levels recorded for men. The authors discuss the major role of gastric acids in the causation of duodenal ulcers. Other important factors are the neurogenic element, the nutritional element, the infectious element and the traumatic element. The higher incidence of hyperacidity among the men may help to explain the greater tendency to intractability of duodenal ulcer among them. The gastric acidity of women suffering from peptic ulcer is usually not abnormal. Neurogenic causes, on the other hand, are usually very apparent among women who have duodenal ulcer. The utilization of this information is obviously of clinical importance when the type and intensity of treatment of duodenal ulcer have to be determined.

"Diasone" in the Treatment of Pulmonary Tuberculosis.

K. H. PFUETZE AND MARJORIE PITS (*Diseases of the Chest*, May-June, 1945), who treated 36 patients suffering from pulmonary tuberculosis with "Diasone", report that the drug fell considerably short of their hopes for a chemotherapeutic adjunct to the treatment of tuberculosis in man. Twenty-two of the patients were mildly and eight moderately intoxicated by the drug. Of four patients with minimal disease, three showed only slight improvement; of fourteen whose disease was moderately advanced, the condition of six was much or moderately improved, while that of four was unimproved or became worse. Five of the patients

who became worse manifested fresh exudative infiltration, and in two of the five cases new cavitation occurred.

Low Blood Pressure.

J. G. M. HAMILTON (*Edinburgh Medical Journal*, May, 1945) has reviewed the literature on the limits of normal adult blood pressure. He is of the opinion that 90 millimetres of mercury should be regarded as the lower limit of normal systolic blood pressure rather than the more commonly accepted figure of 110 millimetres. He states that a systolic blood pressure of between 90 and 110 millimetres is frequently found in normal persons at all ages and is compatible with long life, good health and a high degree of physical efficiency. He states that adults possessing systolic blood pressure between 90 and 110 millimetres are unlikely to develop essential hypertension and that poor vasomotor control and systolic blood pressure within this range do not necessarily occur together. The symptoms of persistent fatigue, dizziness and fainting attacks are not due to persistent subtension, being frequently found in association with "normal" or elevated blood pressure; he thinks that these symptoms are frequently due to psychoneurosis. He discusses postural or orthostatic subtension, a sharp fall of blood pressure occurring on rising from the recumbent to the erect posture and associated with a feeling of faintness. For this condition treatment is suggested by means of the abdominal binder or by very large doses of ephedrine, benzedrine or paredrine.

Pneumococcal Endocarditis.

C. M. TINSLEY (*Archives of Internal Medicine*, February, 1945) discusses pneumococcal endocarditis. The condition occurs with lobar pneumonia, and also as a straight-out bacterial endocarditis, of which condition some 10% to 14% of cases are due to the pneumococcus. The author reports 16 patients, 13 of whom came to autopsy. The vegetations varied greatly in size in pneumococcal endocarditis, from a mere excrescence to a mass which almost filled the ventricle. The aortic and mitral valves were most often affected. Preexisting valvular disease is rarely recorded in the literature, but was present in six of the cases in this series. The portal of entry in twelve cases was the lung (lobar pneumonia). In one patient it followed *otitis media* and mastoiditis, in one pneumococcal meningitis was an antecedent condition, and in two cases no obvious portal of entry was to be found. The heart was usually much enlarged. A hypochromic anæmia and leucocytosis to 20,000 cells per cubic millimetre was generally observed. The pneumococcus was demonstrated in blood cultures in fifteen cases. When pneumococcal endocarditis followed lobar pneumonia, or was associated with that disease, it was usually noted soon after the onset of the pneumococcal infection. Any of the signs of endocarditis might be present, such as purpura, splenic enlargement and rigors; the temperature was nearly always continuously elevated, and the development of a definite heart murmur, especially of aortic incompetence, was a reliable sign. The diagnosis depends on recovery of the organism from the blood in culture. Treatment with sulphonamide drugs has not apparently reduced the mortality rate of pneumococcal endocarditis. Apparent cures have occurred long before sulphonamides were discovered. In all such cases reported a harsh cardiac murmur persisted after recovery. Two apparent cures have been reported recently, one with penicillin and one with penicillin and heparin. Early use of penicillin in suspected cases is indicated.

Meningococcal Endocarditis.

W. R. LOGAN (*Edinburgh Medical Journal*, February, 1945) reviews the condition of meningococcal endocarditis. Only 31 proved cases have been reported in the literature. In the fourteen cases the condition was associated with meningitis, and when death occurred early no clinical evidence of endocarditis was found. In seventeen cases the heart condition occurred without meningitis. In these cases the heart condition was not overshadowed by meningitis, and the symptoms and physical signs were such as are usually found in other forms of bacterial endocarditis, either acute or subacute. The condition differed from chronic meningococcæmia in that the patients were more seriously ill and the fever was more continuous in endocarditis, and there was an absence of that relative well-being of the chronic meningococcæmic patient which is usually notable. Treatment of meningococcal endocarditis has been recorded in eleven cases; six patients were treated with serum and two with sulphanilamide or similar drug. There was one recovery, that of a patient who was given intense sulphonamide therapy over a period of nine months. He received 90 grammes of sulphanilamide, 130 grammes of sulphapyridine and 560 grammes of sulphathiazole. He was very ill and was undoubtedly saved by the treatment. Twenty-nine of the 31 cases recorded by the author were fatal.

Thiouracil in the Treatment of Thyreotoxicosis.

D. M. DUNLOP (*Edinburgh Medical Journal*, January, 1945) briefly reviews the history of the therapy of thyreotoxic disease and the development of thiouracil as a therapeutic agent. The pharmacological action, the clinical application, the dosage, and the effects of the drug upon the blood cholesterol level, the basal metabolic rate, the weight and the pulse rate are discussed. Also the toxic effects, the use of the drug prior to thyreoidectomy, and the ultimate effects of its administration are considered. The author analyses the results of treatment of 39 patients observed over periods of from two to eleven months, and suggests as a result that thiouracil is a drug with great potentialities. It can be given to all patients suffering from thyreotoxicosis with the certainty that improvement will occur after a short latent period. The initial dose should not be larger than 0·6 gramme daily, and this should be administered for at least three weeks and not longer than four weeks, when a maintenance dose should be given. During this initial period, a white blood cell count should be made three times a week, and if it falls below 3,000 per cubic millimetre the drug should be stopped, and if necessary the patient can be prepared for thyreoidectomy with iodine. The maintenance dose should not be more than 0·2 gramme daily and probably 0·1 gramme daily is sufficient. There is little danger of serious toxic reaction or overdosage on this maintenance dose. The author is of the opinion that it is not yet possible to speak dogmatically of the more remote prospects of stoppage of administration of the drug without fear of a return of thyreotoxic signs and symptoms.

Scarlet Fever.

M. J. FOX AND N. F. JORDAN (*Archives of Internal Medicine*, July, 1944) discuss the treatment of scarlet fever and review the literature; they analyse the results of treatment in a series of 2,000 cases. Sulphonamide compounds were found to have their chief value in the treatment of certain complications, but were of no value in the management of the toxic phase or type of scarlet fever. Commercial antitoxin, prepared with horse serum, combats the toxic phase of the disease, but introduces the danger of foreign protein reactions. Pooled human convalescent serum produces rapid clinical response when administered to patients with scarlet fever and offers the best means of therapy. The beneficial effects of its use include prompt subsidence of fever, alleviation of signs and symptoms, avoidance of or lessening of the severity of complications, shortened period of stay in hospital and lower mortality rate. Smaller doses of convalescent serum than have been previously used were found to be effective.

Addison's Disease.

C. F. KEMPER (*Annals of Internal Medicine*, February, 1945) describes the treatment of Addison's anæmia. Since the synthesis of desoxycorticosterone by Reichstein and Steiger in 1937, the standard of potency has become stabilized. Percortin pellets are marketed in 125 milligrammes size and are intended to be used as subcutaneous pellets. Overdosage causing rapid increase in weight or pitting œdema, vascular tension, cardiac dilatation and dyspnœa should be avoided. The author advises the following procedure for implantation. Establish a diagnosis of adrenal cortex insufficiency. Give from three to six grammes of sodium chloride daily. Advise against the use of foods rich in potassium. If the patient is not able to carry on in his usual occupation, begin daily injection of desoxycorticosterone acetate until the adequate daily dosage is determined. Continue the sodium chloride treatment, and within two or three months implant just enough pellets to meet the patient's calculated need. Change the dosage of sodium chloride only when the symptoms indicate the need. Redetermine the patient's daily hormone requirements and reimplant pellets about once a year. Meet such symptoms due to defective metabolism by appropriate dietary supervision and supplemental adrenal extract injections. Meet the complication of crises by supplemental administration of sodium chloride, adrenal extract, and additional synthetic hormone. Encourage the patient by assuring him that a better crystalline hormone compound is in the offing.

British Medical Association News.

SCIENTIFIC.

A MEETING of the New South Wales Branch of the British Medical Association was held on June 21, 1945, at the Royal North Shore Hospital of Sydney. The meeting took the form of a series of clinical demonstrations by members of the honorary medical staff of the hospital.

Patent Ductus Arteriosus.

DR. BRUCE SHALLARD showed a patient with patent *ductus arteriosus*, in whom the distinctive qualities of the characteristic continuous murmur were missing. The patient was a female child, aged seven years. She had attended the hospital since she was six weeks old. She was retarded physically; her weight was two stone eight pounds and the records showed that she had gained only sixteen pounds in five years and four months. The child was pale; no cyanosis or clubbing was present. The systolic blood pressure was 120 millimetres of mercury and the diastolic pressure was 45. The popliteal blood pressure was greater than the brachial. Systolic sounds were audible along the brachial and femoral arteries. A systolic thrill and a rough, grinding, systolic murmur were present to the left of the sternum at the second and third intercostal spaces. Fluoroscopic examination showed that the pulmonary artery was dilated and the left ventricle enlarged. The movements of that chamber were greatly increased. An electrocardiogram showed slight right axis deviation. A diagnosis of patent *ductus arteriosus* was made on the grounds of the systolic pulmonary thrill and murmur, the increased pulse pressure, peripheral arterial bruits, the X-ray appearances and the absence of signs of right ventricular hypertrophy. Dr. Shallard said that it was intended to observe the patient for a further period, and that operation would be recommended whether the murmur became diagnostic or not.

Virilism.

DR. R. A. MONEY and DR. BRUCE SHALLARD conjointly showed two patients suffering from virilism. The first patient was a female, aged twenty years, whose presenting symptoms were obesity, hirsutism, amenorrhœa and headache. She had been overweight for seven years. After the appearance of the menarche at the age of eleven years, menstruation had been regular for two years. Thereafter it had become irregular, and had appeared only once in the last two years. For some years she had had severe frontal headache, which was associated with blurring of the vision for the first five or six hours of the attack. The following physical features were in evidence. Obesity was apparent, her weight being fifteen stone seven pounds (reduced from sixteen stone seven pounds). Her limbs were well formed and not slender. There was coarse, dark hair on the face, arms and legs, and the facies was masculine. The pubic hair was of male distribution. Hypertension was present, the systolic blood pressure being 165 millimetres of mercury and the diastolic blood pressure 95 millimetres of mercury after a resting period. The urine contained no albumin, nor were any purple striæ seen in the skin. The optic fundi and fields of vision were normal. The basal metabolic rate was +7%. The urinary 17-ketosteroids amounted to 15·5 milligrammes per twenty-four hours (a slight increase). Two Aschheim-Zondek tests gave negative results. An excretion pyelogram revealed no renal displacement or other abnormality. The pituitary fossa was normal. The sugar tolerance test resulted in a slightly sustained curve of 130, 180, 158 and 158 milligrammes *per centum* at intervals of half an hour. The insulin tolerance test produced results within the normal range. The cerebro-spinal fluid pressure varied from 270 to 180 millimetres of water; the protein content of the fluid was twenty milligrammes *per centum*, and the Queckenstedt test produced a positive result. The kidneys and suprarenals were radiologically examined by the method of perirenal insufflation of air. This was carried out by means of an artificial pneumothorax apparatus. Five hundred millilitres of air were introduced on the right side and 625 millilitres on the left. The kidney masses were satisfactorily outlined by air, but no adrenal tumour was demonstrable. The virilism in this case was thought to be due to hyperadrenalism, possibly associated with pituitary basophilism, and treatment was being given along endocrinological lines.

The second patient was a female, aged twenty-eight years, who had suffered from obesity since childhood. At the age of twelve years she had weighed seventeen stone. She came from a diabetic family, her two parents and three siblings being diabetic. She herself had had glycosuria for some years. She had always been hairy and had shaved since the age of eleven years. Menstruation was irregular and occurred at intervals of one to three months. Her systolic blood pressure was elevated and ranged between 150 and 180 millimetres of mercury; the diastolic pressure ranged between 100 and 90. A glucose tolerance test produced a typical diabetic curve. An excretion pyelogram revealed no renal displacement. The basal metabolic rate was normal, and skiagrams showed the pituitary fossa to be normal. Perirenal insufflation of air was carried out on each side alternately. By this method of skiagraphy the left kidney appeared abnormally large, although the suprarenal gland could not be visualized as a separate shadow.

An exploratory operation was performed with the assistance of Dr. C. M. Edwards, and the left suprarenal gland was found to be hyperplastic; the major portion was excised. The immediate convalescence was uneventful. Sufficient time had not elapsed for a satisfactory follow-up study, but after three weeks the systolic blood pressure had remained reduced to a level of 130 millimetres of mercury and the diastolic pressure to 90. Dr. Beatrix Durie, the pathologist to the hospital, had examined the portions of the gland removed; multiple cortical adenomata were present, made up of cells resembling those of the *zona fasiculata*. Dr. Durie had commented that such adenomata were not uncommon, and had been found in persons whose metabolism and development were normal.

This case was considered to be an example of the Achard-Thiers syndrome (hirsutism, hypertension and diabetes) associated with adrenal hyperplasia. The chief interest of the two cases was in the use of the method of perirenal insufflation of air for diagnostic purposes. No discomfort had been produced, and no untoward effects had been observed.

Fractures about the Elbow Joint.

DR. A. R. HAMILTON showed a male patient, aged six years, who had injured his left elbow on April 16, 1945. X-ray examination revealed a fracture through the lateral epicondyle with the usual displacement. On April 24, open reduction and suture with catgut were carried out.

Dr. Hamilton next showed a male patient, aged four years, who on February 11, 1945, had fallen off a bicycle. He was unable to move his right arm. The right elbow joint was swollen, contused and tender. On February 12 an X-ray examination revealed a fracture of the lateral condyle with outward rotation. On February 14 open reduction of the fracture was undertaken. The condyle was manipulated into position and secured with three mattress chromicized catgut sutures through the periosteum. On February 17 a further X-ray examination showed the position to be satisfactory, and on February 24 the patient was discharged from hospital. On June 8 the child had 145° of flexion in the joint. He was having active flexion exercises.

The next patient shown by Dr. Hamilton was a female, aged eight years, who on June 2, 1945, had fallen from a scooter. Swelling and discoloration were present around the right elbow. X-ray examination revealed a supracondylar fracture with a little forward displacement. Under general anæsthesia closed reduction of the fracture was performed, and the limb was immobilized in flexion in plaster slabs. The patient was allowed to go home. On June 4 the pulse and movements of the hand were satisfactory. X-ray examination revealed slight forward rotation of the distal fragment of the humerus.

Dr. Hamilton next showed a female patient, aged five years, who on March 29, 1945, had fallen off a scooter and injured her left arm. Extensive swelling was present above the left elbow, with considerable anterior displacement of the lower end of the humerus. A supracondylar fracture was found. On March 31 closed reduction of the fracture was undertaken. The arm was immobilized in a position of 60° of flexion by means of a cuff and collar sling only. At greater flexion no pulse was present. The lower fragment was still displaced. On April 1 the lower fragment was further manipulated, and was brought forward to a satisfactory position. A collar and cuff sling was applied. On April 6 the patient was discharged from hospital; the pulse and the position of the fragments were satisfactory. On May 4 the child had 85° of extension in the joint. On June 8 she had full flexion and 95° of extension.

Acute Osteomyelitis.

Dr. Hamilton finally showed a female patient, aged ten years, who had been admitted to hospital on January 5, 1945, suffering from pain in the left leg of three weeks'

duration, worse for the preceding four days, and from anorexia and lassitude of four days' duration. The child had first complained of pain in the left heel on December 22, 1944. This was much more severe on January 2, 1945, and the patient was unable to walk. She was examined by a private practitioner; her temperature was raised, she had pain in the legs, and tenderness in the left calf was present. On January 4 her temperature rose to 104° F. Considerable tenderness was present over the lower end of the left tibia, and the patient complained of anorexia and lassitude.

On examination, the patient was slightly delirious; her face was flushed. Her left knee was partly flexed and the thigh was abducted and externally rotated. The patient refused to move the left leg. Tenderness was present, pronounced over the lower end of the tibia, with swelling over the same area. This spot was red, blotchy and shiny. The patient was admitted to hospital, and treatment with sulphadiazine was begun, one gramme being given every six hours until a total of 23 grammes had been administered. On January 5 X-ray examination of the left tibia revealed no osseous lesion. On January 8 the whole leg was greatly swollen, and the child was very ill. Considerable fluctuation was observed over the lower end of the left tibia. An incision was made through the skin, fat and periosteum only, and pus welled out. The pus surrounded the bone, lifting the periosteum, and practically the whole shaft was floating in pus. The wound was packed with "Vaseline" gauze, and penicillin was administered, two cubic centimetres of solution being given by intramuscular injection; 10,000 units were given every three hours, the total dose being 1,110,000 units.

On January 10, X-ray examination revealed osteomyelitic changes in the lower end of the tibial shaft. On January 11 culture from the pus yielded a growth of hæmolytic *Staphylococcus aureus*. A back splint was applied. On January 13 a plaster boot was applied. On January 22, an X-ray examination revealed that the periosteal reaction had increased since the previous examination, and the distal third of the tibia was involved in the osteomyelitic process. On January 24 the patient was discharged from hospital; the wound was healthy and there were no sequestra. On March 5 she reported to the out-patient department; the wound was healed. On April 13 the patient began to walk again; no flare-up of the condition occurred.

Constrictive Pericarditis.

DR. DOUGLAS ANDERSON showed a male patient, aged fifteen years, suffering from constrictive pericarditis. He had a paradoxical pulse (the inspiratory weakening was best appreciated with the sphygmomanometer), dilatation of the jugular veins, low blood pressure and pulse pressure and retraction of the xiphisternum and left nipple during inspiration (Wenckebach's sign). Ascites was present, without crural œdema, and the liver was enlarged. The boy had suffered from purulent pericarditis (possibly tuberculous) in Melbourne nine months previously. Pericardiotomy had been performed there, and the wound had healed by first intention. His general health had improved, but massive ascites necessitated frequent aspiration. Dr. Anderson sought the opinions of those present on the indications for and against further surgical treatment.

Poliomyelitis.

Dr. Anderson's second patient was a man, aged twenty-nine years, in whom poliomyelitis had affected the thoracic part of the spinal cord, but not either of the enlargements.

Dr. Anderson said that during the current epidemic of poliomyelitis he had had in his care 25 patients, 20 of whom were paralysed. Of these 20, the paralysis was slight in seven, moderately severe in ten and severe and extensive in three. No patient had died. Four of those who were slightly paralysed and one with moderately severe paralysis had fully recovered; a few others were likely to recover fully. About six seemed likely to have obvious residual paralysis, if not serious crippling.

Dr. Anderson went on to say that the onset of paralysis in several cases had been later and less abrupt than usual, and that the paralysis had ingravesced for several days. The classical stiffness of the spine in the preparalytic stage had been absent in two children who became paralysed. In several children who suffered much pain and stiffness, no paralysis had developed. The cytological findings in and protein content of the cerebro-spinal fluid had borne no relation whatever to the severity of the disease. Dr. Anderson said that he now felt inclined to omit lumbar puncture unless the diagnosis was in doubt.

Referring to complications, Dr. Anderson said that one patient, after being placed on a frame, had developed acute dilatation of the stomach, although her respiratory muscles were not paralysed and her thorax was not restricted. She had been rescued by intubation; but while her circulation was enfeebled, she had developed "pressure sores". Dr. Anderson went on to say that several children had slight dilatation of the heart in the early stages of the disease, and were thought to be suffering from rheumatism. The blood sedimentation rate had been found to be normal or only slightly raised in the febrile stage of poliomyelitis.

Discussing the methods of treatment used in his present series of cases, Dr. Anderson said that the affected parts had been placed in the "neutral rest position" with improvised protection from disturbance. Light, removable splints had been applied, but only so long as pillows, sandbags and blocks were not effective in preventing unsuitable postures; they were also applied to facilitate nursing in the presence of extensive paralysis. These splints were removed for some part of every day, except in the case of two of the patients nursed on frames. Brief, painless stretching of paralysed muscles within physiological limits had not appeared to be harmful; in fact, the evidence obtained seemed to the contrary. Balneotherapy had been employed for one patient, a child with weakness of the shoulder muscles. Dr. Anderson thought it contraindicated during pyrexia. For patients who were heavy and badly paralysed, it required so many assistants and so much time as scarcely to be worth the effort. Also, it was strong medicine; it was easy to give an overdose, and an overdose might well be harmful. Large foments had been applied to painful backs and limbs every two hours during the day. Most patients had said that the foments gave relief. Sometimes a kaolin poultice had been applied, and had seemed to be just as good as foments. When pain was severe or unrelieved by foments, analgesic drugs had been used as well. Aspirin and pethidine, administered together by mouth, had been found excellent for severe pain. At night opium was substituted for pethidine. Carbachol had immediately relieved retention of urine in the preparalytic stage in four cases.

Dr. Anderson said that the labour and devotion of the hospital's small physical therapy staff had been remarkable. They had had few days off duty, and one of their number had contracted poliomyelitis, fortunately in a mild form. Dr. Anderson had admired their finesse in the psychological handling of patients as well as their vigilance and skill. Owing to shortage of staff and the large number of patients, treatment could be carried out only once or twice a day. Some patients had been treated on the orthodox lines laid down by Jones and others, being encouraged to contract each muscle as far as possible, but with restriction of the range of joint motion, so that during movement no muscle was stretched beyond the point from which it could actively return to the normal position against gravity. Other patients had been encouraged to put each joint through its full range of physiological movement so far as was possible without pain, assistance being given when necessary. An attempt was to be made to assess the comparative value of the methods so far as the small number of patients would allow. So far, no harm had seemed to result from the second method. In general, weak muscles were not allowed to bear weight till they were normal or had ceased to improve. Exercise with weight-bearing should not be enough to produce a sense of strain or fatigue. Vigilance was required to detect any retrogression that might follow weight-bearing. Such retrogression had occurred in two cases in the series, but had been temporary only.

In the course of some general remarks on poliomyelitis, Dr. Anderson said that the end-result of the disease, so far as the extent of the paralysis was concerned, was usually determined before the physician saw the patient, for it was determined at the time the paralysis was installed. "Cure" was thus impossible in the absence of some remedy acting upon the infective agent. The word "recovery" was better than "cure" to apply to the improvement that occurred under treatment. It was not possible to predict the final extent of the paralysis when it was first installed, for some of the anterior horn cells of the spinal cord were destroyed, the resultant paralysis being irrecoverable, some were temporarily thrown out of action, the resultant paralysis being temporary, while some were merely deranged, the resultant muscular asynergia and abnormality of postural tone being temporary. One could not tell at the bedside how severely the spinal cord was affected; but in general, if paralysis was extensive, it would be in part irrecoverable. The degree of recovery in the spinal cord upon which the degree of recovery from paralysis depended was independent of what the physician might do to the patient's muscles and joints. The amount of disability caused by paralysis of a given extent might be greater than necessary if the patient lacked correct management of his illness, or if ill-

judged treatment was applied. In one's anxiety to avoid too much fixation or to obtain early locomotion, one might exercise weak muscles to the point of fatigue or past it, so that shortening of the opponents, muscle œdema, fibrosis and contracture might occur. The severity of the disease might be increased if there was much interference with the patient's rest, or if painful manœuvres were carried out, especially during the febrile stage. Prolonged fixation (as for twenty-four hours at a stretch), even in excellent position, might well result in stiffness of muscles. This stiffness was probably due to a sluggishness of the circulation, which caused slight œdema, and this œdema in turn led to fibrosis, which hampered reeducation and tended to cause contracture. In conclusion, Dr. Anderson said that the physician had to be most careful that his interest did not appear to flag, especially if recovery was very slow and a poor result seemed likely. Enthusiastic and vigilant direction of the treatment was more than ever necessary month after month if the maximum response was to be obtained.

Plastic Surgery.

Destruction of the Lower Lip.

DR. BASIL RILEY showed a male patient, aged twenty-three years, whose lower lip had been burnt by molten lead in 1938. The scar continued to break down. In 1940 X-ray therapy was given, and the scar ceased to break down. The patient was admitted to hospital on March 5, 1944. At operation on March 7 the lip was incised and a flap was turned up; the flap was turned across and sutured into the defect. He was discharged from hospital on March 31 and readmitted on July 23. On July 25 a flap of buccal mucous membrane was let in along the remaining margin of the lower lip. On August 22 an acromio-pectoral tube pedicle was raised, and the patient was discharged from hospital on September 4. He was readmitted to hospital on September 29. On October 3 the medial end of the pedicle was detached from the chest wall and attached to the area at the left lateral border of the mouth, from which a small area of skin was excised. On December 5 the first stage of reconstruction of the lower lip was undertaken. The base of the pedicle was freed and swung up into an incision down the right side of the chin. The patient was discharged from hospital on December 20. He was readmitted to hospital on April 29, 1945. At operation on May 1 the existing lower lip was excised. The pedicle was incised and the lower margin of the split pedicle was sutured to the free edge of the lip. The upper margin of the pedicle was united with the upper border of the lip. The patient was discharged from hospital on May 10 and readmitted on June 10. At operation the tube graft was divided and the tube was narrowed.

Destruction of Face by Electric Sparks.

Dr. Riley next showed a male patient, aged twenty years, who in June, 1942, had fallen under an electric train. The left arm was severed below the elbow, and two toes were amputated. Electric sparks coagulated the left orbital contents, the soft tissues sloughed and some sequestra were discharged. The patient was admitted to hospital for plastic repair on March 5, 1944. On that day a flap was dissected off the forehead and turned down to cover the granulations in front of the orbit; the forehead and the outer end of the flap were covered with a Thiersch graft. On April 18 curettage of the ethmoid region was carried out. On May 2 a skin graft from the left thigh was applied to the orbit; the flap was extended. The patient was discharged from hospital, and readmitted on July 17, 1944. On July 25 an acromio-pectoral tube pedicle was raised. On August 8 the tube pedicle was lined. On September 5 the medial end of the pedicle was freed; the end was relined and reattached in the same position, as too much tension was necessary in rotating it. On September 19 the pedicle was rotated to the left arm. On October 31 the base of the pedicle was reduced. The patient was discharged from hospital on November 15.

He was readmitted to hospital on December 5 and discharged again on December 12, no further plastic procedures having been carried out. On April 22, 1945, he was again readmitted to hospital. On April 30 the inlaid pedicle was freed and the tube graft was let in. On June 12 the lateral end of the lower half of the supraorbital tube pedicle was advanced.

Scarring of Cubital Fossa by Direct Trauma.

Dr. Riley's third patient was a female, aged thirteen years, who had been knocked down by a motor-car in 1940. She had remained in hospital for six weeks at that time, owing to a wound to the left cubital fossa; limited extension followed healing and scar tissue formation. She was admitted to the Royal North Shore Hospital on November 19, 1944. At operation, on November 21, a keloid on the flexor aspect of the left elbow was excised; the skin edges were approximated over the exposed area by freeing the subcutaneous tissues and by further incisions. The skin edges were sutured by interrupted black silk sutures. The patient was discharged from hospital on December 8; the wound was healthy and the arm was kept in a splint.

Destruction of Alæ Nasæ by Basal-Cell Carcinoma.

The next patient shown by Dr. Riley was a male, aged sixty-two years, who in January, 1944, had been treated by radium for a basal cell carcinoma of the nose. He was admitted to hospital on July 2. Three operations were performed: (i) excision of the basal cell carcinoma and the insertion into the exposed area of a tube pedicle graft; (ii) third stage operation to the tube pedicle graft; (iii) fourth stage operation to the tube pedicle graft.

Destruction of the Lower Lip by Squamous-Cell Carcinoma.

Dr. Riley next showed a male patient, aged thirty years, who in 1932 had received treatment by radium and diathermy for a sore on his lip. Further radium treatment was given in 1938. One year later necrosis developed. He was admitted to hospital on March 6, 1944; he then had a fistula through into his mouth. On March 7 an acromio-pectoral tube pedicle was raised, and biopsy material was taken from the chin. On April 18 the second stage procedure to the tube pedicle graft was carried out; the base of the tube was lined. On May 9 the lower lip was excised; the tube pedicle was transplanted to the chin. On June 20 the area of malignant infiltration of the lip and chin was excised, and the gap was closed by rotation of a flap. On July 18 more infiltrated tissue was excised; the pedicle was inserted. On August 15 the pedicle was divided near the right-hand base; the skin edges of the base were cut into alignment and sutured; the remainder of the pedicle was attached to the face below the left angle of the mouth. On October 3 the centre of the pedicle was incised longitudinally and attached to the face below the mouth. On November 7 the first stage of reconstruction of the lower lip was undertaken, and on December 5 the second stage. Pathological examination of the biopsy specimen revealed squamous carcinoma. The patient was discharged from hospital on December 22. On April 8, 1945, he was readmitted, and on May 18 a further operation was performed for the thinning out of the flap on the right side of the chin, excision of hair follicles in the graft over the lip and trimming of the ends of the graft. The patient was discharged from hospital on May 23.

Pulmonary Tuberculosis with Effusion.

DR. M. P. SUSMAN showed a male patient, aged thirty-three years. In June, 1939, whilst playing tennis, the patient had a sudden hæmoptysis; the blood, which was almost pure and fresh, was coughed up without any warning. This coughing up of blood continued intermittently for two days, one or two mouthfuls being produced at each attack. The patient attended the chest clinic at the hospital, and a diagnosis of pulmonary tuberculosis was made. In August, 1939, right artificial pneumothorax was induced; it was continued uneventfully for six years, the patient being able to carry on his work as a teacher. On April 10, 1945, whilst teaching, the patient noticed a sudden pain in the thighs spreading down the legs; the pain felt like the initial stages of influenza. He had no pain in his chest at any time. His temperature rose that night to 103° F., and he began to have an irritating cough with a feeling of pressure in his throat. The pain in his legs stopped after two days, after he had taken some "pills". The nightly rise in temperature to 103° F., with a fall in the mornings, continued for three weeks until he was admitted to hospital. He obtained relief a few days after the first aspiration on the right side (May 5), when fourteen ounces of pus were removed. Examination of a smear of the pus revealed numerous neutrophile pus cells, but no acid-fast bacilli or other organisms; culture yielded a growth of hæmolytic *Staphylococcus aureus*. On May 15 three millilitres of penicillin solution were instilled after the aspiration of nineteen ounces of material. Aspiration and the instillation of penicillin solution were repeated every two or three days. On May 30 the material aspirated was sterile, and it remained so. At the time of the meeting the amount obtained by aspiration averaged six ounces every second day. The patient had no elevation of temperature, he felt well and his lung was expanding slightly. Dr. Susman said that the patient had been fluoroscopically examined nearly every week since his

admission to hospital. No acid-fast bacilli were found on microscopic examination of the pleural fluid. A specimen had been sent for cultural examination and for test in a guinea-pig. The following figures had been given for the blood sedimentation rate: May 5, 22 millimetres in one hour; May 17, 20·5 millimetres in one hour; May 29, 19 millimetres in one hour; June 13, 14·5 millimetres in one hour. A blood count on May 5 gave the following information: the erythrocytes numbered 3,450,000 per cubic millimetre, the leucocytes numbered 12,400 per cubic millimetre, the hæmoglobin value was 74% and the colour index was 1·05. Numerous examinations of the sputum had failed to reveal acid-fast bacilli, and attempts at culture were unsuccessful.

Colpocleisis.

DR. W. D. CUNNINGHAM showed a female patient, aged eighty-three years, who had been admitted to hospital on March 25, 1945. She had suffered from loss of control of her urine, especially on standing or walking, for six months, and from prolapse of the uterus for twenty years; the prolapsed mass had been completely outside the vagina for the last six months, and was specially noticeable to her when she stood or walked about. She had no vaginal discharge or hæmorrhage, but she suffered from acute lower abdominal pain and backache on walking. Œdema of the ankles developed after walking. She could walk only with extreme difficulty, owing to the discomfort of the prolapsed uterus between her legs. She had had five children, and after the birth of the fifth child, forty years earlier, she had undergone an operation for perineal repair. Her blood pressure was high; she had had a stroke seven years earlier.

On examination of the patient, her temperature was 98·4° F., her pulse rate was 84 per minute and her respirations numbered 20 per minute. The systolic blood pressure was 160 millimetres of mercury and the diastolic pressure was 80. The pulse was regular in rate and amplitude. The apex beat was displaced to the left, and was in the fifth left intercostal space. The heart sounds were audible in all areas and regular; there were no murmurs. Œdema was present in the ankles and over the sacrum. The respiratory and central nervous systems were normal. Tenderness was present in the left hypochondrium, and some liver tenderness was noted. Vaginal examination revealed a urethrocele and complete *prolapsus uteri* while the patient was lying in bed; the body of the uterus was atrophied and barely palpable, and the cervix was atrophied and invisible; the vaginal epithelium was thickened and of the colour and consistency of cutaneous epithelium.

The patient was kept completely at rest. Twice a day the prolapsed uterus was douched with warm "Dettol" solution. She was given "Luminal" (two grains as required), "Anahæmin" (four cubic centimetres immediately by intramuscular injection), "Fersolate" (one tablet three times a day), and "Vibex" (one tablet three times a day). Operation was performed on April 3. Premedication consisted of the administration of 100 milligrammes of pethidine and 1/250 grain of hyoscine one hour before the patient was taken to the operating theatre. Local anæsthesia was used, and the duration of the operation was one and a half hours. The prolapsed uterus was found to be small and atrophic, and pronounced rectocele and cystocele were present. A vaginal toilet was carried out. Rectangular areas measuring three inches by half an inch were removed from the anterior and posterior vaginal mucosa. The raw surfaces were approximated with mattress sutures while the cervix and uterus were tucked back. Canals were left down each lateral wall for drainage of cervical secretions. An ordinary posterior colpoperineorrhaphy was then performed, with resection of the posterior vaginal wall and approximation of the levatores and repair of the perineal body.

On April 4 a course of sulphadiazine treatment was begun, four tablets being given at once and two tablets every six hours. A potassium citrate mixture was administered in a dosage of four drachms every four hours. On April 5 some œdema of the vulva was found to have developed since the patient was placed in Fowler's position. The foot of the bed was raised, and glycerin and magnesium sulphate paste was applied. On April 12 the patient's general condition was excellent; the œdema had practically gone, and the state of the perineum was good. On April 19 a superficial wound infection of the perineum was present; penicillin was applied locally. By April 22 the wounds had healed well. On April 28 the patient's condition was excellent, and she was discharged to a convalescent home.

Erythroblastosis Fœtalis.

DR. STUART STUDDY showed a female patient, aged thirty years, who had had three pregnancies. The first pregnancy, four years earlier, had been normal. The second pregnancy had resulted in the birth, on February 22, 1944, of an infant suffering from *erythroblastosis fœtalis*; the child had lived for twenty-two hours. The birth weight was nine pounds nine ounces. The mother's blood belonged to group A, and was Rh-negative; the baby's blood belonged to group O, and was Rh-positive. At autopsy the infant was found to be pale, slightly jaundiced and affected by slight generalized œdema; foci of erythropoiesis were present in the liver, the skin of the scalp, the suprarenals and the heart wall. A blood count gave the following information: the erythrocytes numbered 1,510,000 per cubic millimetre, the hæmoglobin value was 47% (7·05 grammes *per centum*), and the colour index was 1·5; anisocytosis, macrocytosis, poikilocytosis, polychromasia and stippled cells were present.

The third child was born on May 26, 1945; the expected date of confinement was July 21. The mother had had a considerable increase in weight during the last two months of pregnancy. On May 21 an X-ray examination revealed one fœtus, presenting by the head, with the spine in the anterior position. Labour began at 3 p.m. on May 24, and the membranes ruptured at 10 p.m. on May 25. A lower segment Cæsarean section was performed at 1.30 a.m. on May 26 for three reasons: (i) no progress was being made, although uterine contractions were satisfactory; (ii) antepartum hæmorrhage was occurring; (iii) albuminuria was present. The fœtus was affected by *hydrops fœtalis*, and lived for fifty minutes; the birth weight was five pounds thirteen ounces, and the length was eighteen inches. A count of the mother's blood showed that the erythrocytes numbered 3,010,000 per cubic millimetre, and the hæmoglobin value was 63% (9·45 grammes). A count of the baby's blood gave the following information: the erythrocytes numbered 1,030,000 per cubic millimetre, the hæmoglobin value was 38% (5·7 grammes *per centum*); pronounced anisocytosis, macrocytosis, poikilocytosis and polychromasia were present. Of the normoblasts, orthochromic cells numbered 11,200 per millilitre, polychromic cells 20,220 per millilitre, basophile cells 12,040 per millilitre, mitotic cells 1,400 per millilitre and hæmatocytoblasts 4,480 per millilitre; the leucocytes numbered 6,720 per millilitre, 87 neutrophile cells and 47 eosinophile cells being seen; 56% of the leucocytes were lymphocytes. Nucleated cells numbered 56,000 per cubic millimetre; 1·2% were leucocytes and 88% were immature erythrocytes.

At autopsy the infant was seen to be a male child presenting the classical picture of *hydrops fœtalis*. The placenta was thickened, pale and friable, and weighed three pounds twelve ounces. Generalized œdema and anasarca, slight jaundice and petechial hæmorrhages (especially numerous over the back of the trunk) were present. The connective tissue was affected by a peculiar gelatinous œdema, especially noticeable in the scalp and the mesentery. The cerebrospinal fluid was increased in amount. Pleural and pericardial effusions of moderate size were present. The brain was small, the thyreoid gland was not enlarged, and the thymus weighed two grammes. The lungs were completely unexpanded, and the heart was enlarged and œdematous.

Dr. Studdy said that he was indebted to Dr. Beatrix Durie for the autopsy and pathological information. J. R. Gilmour had described the features of *hydrops fœtalis* of type I, occurring in infants living for not more than thirty-six hours, in the following terms: (i) lipoid infiltration of the suprarenal cortex (occurring in no other condition); (ii) familial incidence; (iii) general œdema and serous effusions; (iv) bone changes resulting from diminished osteoblastic activity; (v) hæmosiderosis and abnormal hæmatopoiesis in the liver; (vi) increase of reticulin in the liver; (vii) increase in size and number of the islets of Langerhans; (viii) enlargement of the liver, spleen and placenta, and hypoplasia of the thymus.

NOTICE.

THE General Secretary of the Federal Council of the British Medical Association in Australia has announced that the following medical practitioners have been released from full-time duty with His Majesty's Forces and have resumed civil practice as from the date mentioned:

Dr. Lennox Price, Union Bank Chambers, Bolton Street, Newcastle (September 1, 1945).

Dr. W. G. Holt, 33, Darlinghurst Road, Darlinghurst (September 1, 1945).

Medical Societies.

THE MEDICAL SCIENCES CLUB OF SOUTH AUSTRALIA.

A MEETING of the Medical Sciences Club of South Australia was held at the Institute of Medical Science, Adelaide, on April 6, 1945.

Pneumonia.

PROFESSOR E. R. TRETHEWIE presented a paper entitled "Studies in Pneumonia". He stated that the aspect he proposed to discuss was the liberation of pharmacologically active substances as detected in the intact animal and in the isolated organs. It was precisely these substances, which were inactive when contained inside the cell, which were responsible for much of the clinical condition of the patient following its liberation.

This was not the only way in which symptoms were produced; there might be reflex nervous effects and also direct effects caused by the injurious agent. Investigations had been carried out on man and on the isolated pneumonic lung of the cat.

The first substance to be considered was histamine. This was a normal constituent of the cell. Under the influence of various conditions it was liberated from the cell and was then harmful. The assay then depended on the fact that histamine had been extracted from the organ concerned and the contraction of the isolated guinea-pig jejunum gave a similar value for the histamine content as had been shown for the chemical extraction. Further proof was given by the assay also on the cat blood pressure which gave comparable values. Two other assays would establish certain identity with histamine, and this had been done in other forms of tissue injury. The lung was perfused through the pulmonary artery. The perfusion fluid used was tyrode. Following perfusion through the lung a substance appeared in the perfusion fluid which caused immediate contraction of the gut, and the assay on the cat blood pressure when the concentration was high gave the same histamine equivalent as the gut. This histamine appeared in small amounts only in the intravascular fluid. Larger amounts were detected in the tracheal fluid, and when in addition the lymphatic vessels were opened much more was detected. It appeared that most of the histamine passed into the lymphatic channels and possibly the trachea. Some qualification for these results was required, since the lung was ventilated at a positive pressure. It was essentially a local activity and most of its action took place at the site of its liberation. When diluted blood was used it was necessary to show that this fluid was without activity on the gut. The blood was centrifuged and the blood only tested. Since the plasma which was tested after being perfused through the lung had been diluted with tyrode, substances might pass from the lung to the vascular fluid owing to the presence of a pressure gradient, while presumably equilibrium had been established previously between it and the plasma. The findings corresponded with those obtained when the lung was perfused with tyrode. Difficulties appeared because of the activity of the plasma. The response of the guinea-pig jejunum was moderately rapidly acting. When such a response did occur it was rarely due to histamine, as was shown by the fact that, while one gut might respond with a contraction equivalent to that produced by a certain amount of histamine, the same fluid tested on a gut from another guinea-pig showed a delayed response with a latency of several seconds and a small contraction. The substance producing a delayed response in the gut which was liberated from the lung produced slower contraction of the gut with a slower relaxation.

Another substance was liberated which was an enzyme acting on adenyl compounds. The blood normally contained some enzyme. Adenyl compounds caused cardiac depression. The detection of these substances was made upon the guinea-pig heart preparation. The compounds caused depression of the heart beat, causing a fall in the excursion shown on the tracing. When a solution containing the enzyme was allowed to act on this substance prior to the testing, the cardiac depression was much reduced. In this way a quantitative assay was possible. The histogram showed activity from ten specimens of normal blood, the ordinate being the number of cases, the abscissa the percentage activity of the lacarnol which was added after incubation. In human subjects, deaminating enzyme appeared in the blood in increased amounts when the patient had pneumonia. The content fell to a normal level with recovery. An instance was shown of the activity of the plasma obtained from a patient ill with pneumonia. The patient was very ill. Following recovery the activity returned to a normal average figure. The isolated perfused lung liberated a deaminating enzyme on perfusion. Some enzyme activity was found in the perfusion fluid from the practically normal lung, and this was increased in the case of bronchopneumonia. In addition, in the case of the perfusion fluid obtained from the diseased lung, there was an immediate depression in the activity of added adenosine. This did not occur with the normal lung. The difference in the enzyme activity of vascular fluid and lymphatic fluid was not so great as was the case with histamine. It would seem not unlikely that the increase in deaminating enzyme in the blood in pneumonia was due to liberation of enzyme from the lung.

Another substance was liberated and was readily shown when diluted heparinized blood was perfused through the lung. The blood which had passed through the lung would remain fluid, while control blood would clot. It had been shown that the anti-coagulant activity of heparinized fluid was increased after perfusion through the pneumonic lung. Were protamine to hand, it would be worth while to see if this substance antagonized the inhibition of coagulation. If so, it would suggest that the anti-coagulant liberated was heparin. Unfortunately, this was not possible. Previous work had indicated that the liver was the source of heparin, but Professor Trethewie's findings suggested that the perfused lung had a similar property and this phenomenon might be more general. It was not unlikely that it was a biological phenomenon which aided non-coagulation of the blood in the intact animal wherever it might be. Since cut-up pieces of lung increased the coagulability of the fluid, it was suggested that the substance responsible was intimately associated with the vessels, for perfusion of the vessels allowed the fluid to acquire this diminished coagulability. An attempt had been made to assess the amount of anti-coagulable substance liberated with reference to heparin. It was seen from a table shown that in the case of the moderately diseased lung more than 0·07 to 0·026 milligramme of heparin equivalent was liberated per millilitre, as the smaller amount still did not allow so much coagulation in the perfusion fluid as did the larger quantity of heparin in the control fluid. With the slightly diseased lungs the output appeared to be of the order of 0·05 milligramme per millilitre.

Correspondence.

TWO PELVIC TUMOURS.

SIR: I should like to report two cases that may be of interest, if only on account of their rarity.

CASE I.—Mrs. B. consulted me in November, 1936, with a history of having had a very bad labour and a stillborn child a year or so previously. She had missed a period and was anxious to have a living child. On examination, a large tumour was found in the left side of the pelvis and the uterus was enlarged to corresponding size of amenorrhœa. I advised operation, and on laparotomy found a large ovarian tumour approximately six inches long by two and a half inches in diameter. There was a deformed right tube and no evidence of ovary on that side, but I considered that there was a small piece of tissue in the broad ligament representing under-developed ovarian tissue.

The tumour was removed together with the appendix, and injections of *corpora lutea* (Parke, Davis and Company) were given over a period of some weeks. She carried to term and was delivered of a living female on June 11, 1937.

She was given stilboestrol for some menopausal symptoms which cleared up, and in a personal communication on June 3, 1945, stated that she was feeling well, but had not menstruated since.

The interesting points are, of course: (i) unilateral ovary (no previous operation); (ii) the continuance of pregnancy after removal of a *corpus luteum* of only two months' duration. In view, especially, of correspondence recently in the *British Medical Journal* I would be inclined to wait to term in a similar case and act then in the appropriate manner.

CASE II.—Miss C., aged seventeen years, consulted me early in January, 1945, complaining of acute pain in the right iliac fossa. She admitted to two previous operations for this same pain—the first for appendicitis(?) and the second twelve months ago, when the surgeon is stated to have said that he "cleared up a lot of rubbish" (? adhesions). On

examination *per rectum* I found a large hard tumour in the right broad ligament, about three inches in diameter, and after observation for a few days to confirm the severity of the symptoms advised surgery.

At operation I found no appendix, right ovary or tube (these had evidently been removed previously), and I removed the mass situated in the layers of the broad ligament with no connexion to the uterus. I reconstituted the broad ligament and closed the abdomen. The pathologist reported "fibromyoma". This tumour is apparently rare in one so young. The central degeneration was the probable cause of her pain, as she has remained well since.

Yours, etc.,

J. LLOYD SIMMONDS.

Wickham House,
Wickham Terrace,
Brisbane.
August 8, 1945.

A CASE OF LOCHIOMETRA.

SIR: The following report on a simple though rare case seems worthy of publication.

Mrs. S., aged thirty-six years, a *secundigravida*, was confined at the Women's Hospital on December 5, 1944, after twenty-four hours of mild primary uterine inertia. The puerperium was normal up to the time of discharge from hospital on December 19, 1944.

On December 22, 1944, she had an attack of diarrhœa with abdominal pain, for which she was attended by a colleague. She was well in a few days, and as the lochia had now disappeared, she believed her recovery was complete. However, on January 3, 1945, she came to my office complaining of great depression with enlargement and discomfort of the abdomen, present for one week, and increasing from day to day. She was restless and pale; her temperature and pulse were normal. Extending to two inches above the umbilicus was a large tumour, elastic and tender. On vaginal examination no uterus could be felt apart from the tumour, which bulged strongly into the posterior fornix, and gave the impression of a large ovarian cyst. On my passing the finger through the cervix, a little thick, tarry blood appeared, of which there was soon sufficient to necessitate the application of a pad.

The next day the patient felt better, and the tumour was appreciably smaller, while the lochia continued. On February 1, 1945, the lochia had ceased and the tumour vanished.

Lochiometra is a simple pathological condition, whose recognition depends entirely upon bearing it in mind; failure to do so might easily lead the unwary into an unfortunate surgical error. I report the case as neither I nor several of my colleagues with wide obstetrical experience have hitherto encountered a case of this type. The delayed onset is particularly noteworthy.

Yours, etc.,

H. W. HORN.

Wickham Terrace,
Brisbane,
August 8, 1945.

THE ROYAL NAVAL MEDICAL SERVICE AND AUSTRALIA.

SIR: With the end of hostilities in the Pacific we should like to take this opportunity of thanking the British Medical Association in Australia for all that has been done for the medical officers of the Royal Navy.

The meetings which have been arranged for us, the copies of THE MEDICAL JOURNAL OF AUSTRALIA which week by week have been sent to us, and the way in which the columns of the journal have been open to us have been very much appreciated by us all. Incidentally, may we say how highly we have come to value the Australian journal and the high standard of its contents.

The individual kindnesses which we have received from officials and members of the Association are too numerous to mention, but naval medical officers will long remember the help they have received from Dr. Hunter, the Secretary of the Association, from Miss Rolleston, the librarian, who has gone to endless trouble to supply our literary wants, and from you, sir, who have been so kind regarding all matters relating to the journal.

When we leave Australia we shall carry away with us very happy memories of the Australian part of our great British Medical Association. On behalf of the Royal Naval medical officers in Australia and in the British Pacific Fleet, will you please allow us a further kindness in the use of your columns to express our sincere thanks to the British Medical Association in Australia.

Yours, etc.,

J. A. MAXWELL,
Surgeon Rear Admiral, Medical Officer in Charge, Royal Naval Hospital, Sydney.

A. W. GUNN,
Surgeon Captain, Royal Navy, Fleet Medical Officer.

LAMBERT ROGERS,
Surgeon Captain, Royal Naval Volunteer Reserve, Surgical Consultant, British Pacific Fleet.

Sydney,
August 29, 1945.

OLLIER'S DISEASE AND MULTIPLE EXOSTOSES.

SIR: Since the publication of the report of a meeting of the New South Wales Branch of the British Medical Association at the Royal Prince Alfred Hospital, Sydney (THE MEDICAL JOURNAL OF AUSTRALIA, August 4, 1945, page 158), at which I showed several children, Dr. H. R. Sear has called my attention to the fact that, in his opinion, Ollier's disease and multiple exostoses are not synonymous terms, but represent different congenital abnormalities which may merge with one another. He has shown me X-ray slides demonstrating the obvious differences between the two conditions. My authority for using these terms as meaning the same condition is Brennemann's "Practice of Pædiatrics", Volume IV, Chapter 36, page 6, written by Albert H. Montgomery. Having a very high respect for Dr. Sear's radiological experience in bone conditions, I feel that I should publish his opinion.

An error occurs in the text description of this case; "diaphyseal achalasia" should read "diaphyseal aclasis".

Yours, etc.,

NORMAN CUNNINGHAM.

185, Macquarie Street,
Sydney,
August 14, 1945.

NOTIFICATION OF HYDATID DISEASE IN VICTORIA.

SIR: Recently I wrote to you on the above subject, asking for the cooperation of medical practitioners in Victoria in securing the uniform notification of cases of hydatid disease, so as to enable local health authorities to take measures to prevent its spread.

It has been suggested to me that as hydatid cysts take long to develop, any action which local authorities might take would be too belated to have any effect on the incidence. That this is not always so is shown by a case which occurred in recent years in the Western Health Area.

The patient, a child, aged four years, was admitted to a provincial hospital suffering from hydatid disease. The case was reported to the local authority. The municipal health inspector reported to the medical officer of health as follows:

> I called on the parents and learned that the child had a pet dog which she was constantly fondling. The family did not feed the dog on raw meat, but on following the matter up further I found that at the local slaughter house there was exposed a heap of raw offal which this dog and others from the township were in the habit of visiting. I have taken the appropriate legal action which has successfully secured a discontinuance of this practice.

Surely action such as this helps to prevent other children becoming infected?

Yours, etc.,

GEORGE COLE,
District Health Officer,
Western Health Area.

Geelong,
Victoria,
August 25, 1945.

Obituary.

JAMES THOMAS WILSON.

WE regret to announce the death of Professor James Thomas Wilson, which occurred on September 2, 1945, at Cambridge, England.

The Royal Australasian College of Physicians.

NOTICE.

MEMBERS of the medical profession are invited to be present at a lecture entitled "Chemotherapeutic Suppression and Prophylaxis in Malaria" to be delivered by Brigadier N. Hamilton Fairley, C.B.E., F.R.S., Director of Medicine, Australian Army Medical Corps, in the lecture hall, Royal Australasian College of Surgeons, Spring Street, Melbourne, on Thursday, September 13, 1945, at 8.15 o'clock p.m.

University Intelligence.

THE UNIVERSITY OF MELBOURNE.

DIPLOMA OF OPHTHALMOLOGY, PART I.

THE Registrar of the University of Melbourne announces that courses of instruction in anatomy and physiology, suitable for candidates for the examination for the Diploma of Ophthalmology, Part I, will be arranged to commence in the week beginning September 17, 1945. Intending candidates should lodge enrolment cards without delay at the office of the Registrar.

Australian Medical Board Proceedings.

NEW SOUTH WALES.

THE undermentioned additional qualifications have been registered, pursuant to the provisions of the *Medical Practitioners Act*, 1938-1939, of New South Wales:

D'Ombrain, Arthur Wolseley (M.B., Ch.M., 1923, Univ. Sydney), D.O.M.S., England, 1925, F.R.A.C.S. (Oph.), 1945, Newcastle.

McGregor, Alexander Roy (M.B., B.S., 1939, Univ. Sydney), M.R.A.C.P., 1945, 118 A.G.H., Australia.

Naval, Military and Air Force.

CASUALTIES.

ACCORDING to the casualty list received on August 30, 1945, Lieutenant-Colonel R. G. Williams, A.A.M.C., North Cottesloe, Western Australia, has been placed on the "seriously ill" list.

Medical Appointments.

Dr. A. B. Hewitt has been appointed a Commissioner of the Koo-wee-rup Waterworks Trust, Victoria, for a period of four years, subject to the provisions of the *Water Acts*.

Nominations and Elections.

THE undermentioned have applied for election as members of the New South Wales Branch of the British Medical Association:

Bunn, Terence Aubrey, M.B., B.S., 1945 (Univ. Sydney), Mater Misericordiæ Hospital, Waratah.

Perry, David Clayton, M.B., B.S., 1945 (Univ. Sydney), Royal Prince Alfred Hospital, Sydney.

Diethelm, Anton Emil, M.B., B.S., 1941 (Univ. Sydney), "Cheddington", 9, Rosemont Avenue, Woollahra.

Fraser, Allan Arthur, M.B., B.S., 1945 (Univ. Sydney), 36, Carlton Parade, Carlton.

Molesworth, Edmund James Cairns, M.B., B.S., 1939 (Univ. Sydney), 33, William Street, Double Bay.

Jones, Lloyd James, M.B., B.S., 1944 (Univ. Sydney), Prince Henry Hospital, Little Bay.

Diary for the Month.

SEPT. 11.—New South Wales Branch, B.M.A.: Executive and Finance Committee.
SEPT. 11.—Tasmanian Branch, B.M.A.: Ordinary Meeting.
SEPT. 14.—Queensland Branch, B.M.A.: Council Meeting.
SEPT. 17.—Victorian Branch, B.M.A.: Hospital Subcommittee.
SEPT. 17.—Victorian Branch, B.M.A.: Finance, House and Library Subcommittee.
SEPT. 18.—Victorian Branch, B.M.A.: Organization Subcommittee.
SEPT. 18.—New South Wales Branch, B.M.A.: Medical Politics Committee.
SEPT. 19.—Western Australian Branch, B.M.A.: General Meeting.
SEPT. 20.—South Australian Branch, B.M.A.: Council Meeting.
SEPT. 20.—Victorian Branch, B.M.A.: Executive Meeting.
SEPT. 20.—New South Wales Branch, B.M.A.: Clinical Meeting.
SEPT. 25.—New South Wales Branch, B.M.A.: Ethics Committee.
SEPT. 26.—Victorian Branch, B.M.A.: Council Meeting.
SEPT. 27.—New South Wales Branch, B.M.A.: Branch Meeting.
SEPT. 28.—New South Wales Branch, B.M.A.: Annual Meeting of Delegates.
SEPT. 28.—Queensland Branch, B.M.A.: Council Meeting.
OCT. 2.—New South Wales Branch, B.M.A.: Council Quarterly Meeting.

Medical Appointments: Important Notice.

MEDICAL PRACTITIONERS are requested not to apply for any appointment mentioned below without having first communicated with the Honorary Secretary of the Branch concerned, or with the Medical Secretary of the British Medical Association, Tavistock Square, London, W.C.1.

New South Wales Branch (Honorary Secretary, 135, Macquarie Street, Sydney): Australian Natives' Association; Ashfield and District United Friendly Societies' Dispensary; Balmain United Friendly Societies' Dispensary; Leichhardt and Petersham United Friendly Societies' Dispensary; Manchester Unity Medical and Dispensing Institute, Oxford Street, Sydney; North Sydney Friendly Societies' Dispensary Limited; People's Prudential Assurance Company Limited; Phœnix Mutual Provident Society.

Victorian Branch (Honorary Secretary, Medical Society Hall, East Melbourne): Associated Medical Services Limited; all Institutes or Medical Dispensaries; Australian Prudential Association, Proprietary, Limited; Federated Mutual Medical Benefit Society; Mutual National Provident Club; National Provident Association; Hospital or other appointments outside Victoria.

Queensland Branch (Honorary Secretary, B.M.A. House, 225, Wickham Terrace, Brisbane, B.17): Brisbane Associated Friendly Societies' Medical Institute; Bundaberg Medical Institute. Members accepting LODGE appointments and those desiring to accept appointments to any COUNTRY HOSPITAL or position outside Australia are advised, in their own interests, to submit a copy of their Agreement to the Council before signing.

South Australian Branch (Honorary Secretary, 178, North Terrace, Adelaide): All Lodge appointments in South Australia; all Contract Practice appointments in South Australia.

Western Australian Branch (Honorary Secretary, 205, Saint George's Terrace, Perth): Wiluna Hospital; all Contract practice appointments in Western Australia. All Public Health Department appointments.

Editorial Notices.

MANUSCRIPTS forwarded to the office of this journal cannot under any circumstances be returned. Original articles forwarded for publication are understood to be offered to THE MEDICAL JOURNAL OF AUSTRALIA alone, unless the contrary be stated.

All communications should be addressed to the Editor, THE MEDICAL JOURNAL OF AUSTRALIA, The Printing House, Seamer Street, Glebe, New South Wales. (Telephones: MW 2651-2.)

Members and subscribers are requested to notify the Manager, THE MEDICAL JOURNAL OF AUSTRALIA, Seamer Street, Glebe, New South Wales, without delay, of any irregularity in the delivery of this journal. The management cannot accept any responsibility or recognize any claim arising out of non-receipt of journals unless such a notification is received within one month.

SUBSCRIPTION RATES.—Medical students and others not receiving THE MEDICAL JOURNAL OF AUSTRALIA in virtue of membership of the Branches of the British Medical Association in the Commonwealth can become subscribers to the journal by applying to the Manager or through the usual agents and booksellers. Subscriptions can commence at the beginning of any quarter and are renewable on December 31. The rates are £1 for Australia and £2 5s. abroad *per annum* payable in advance.